Chemical Engineering

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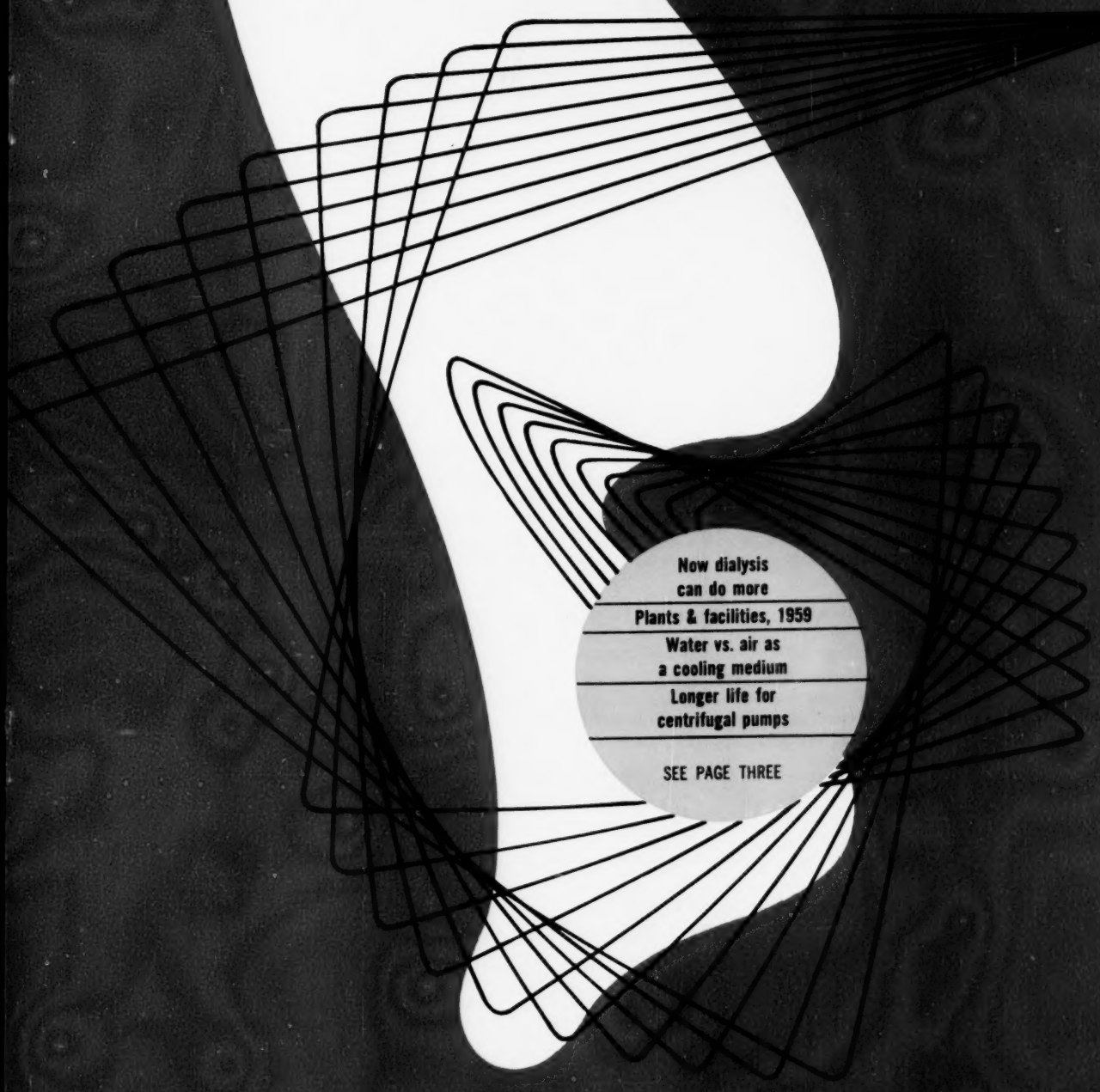


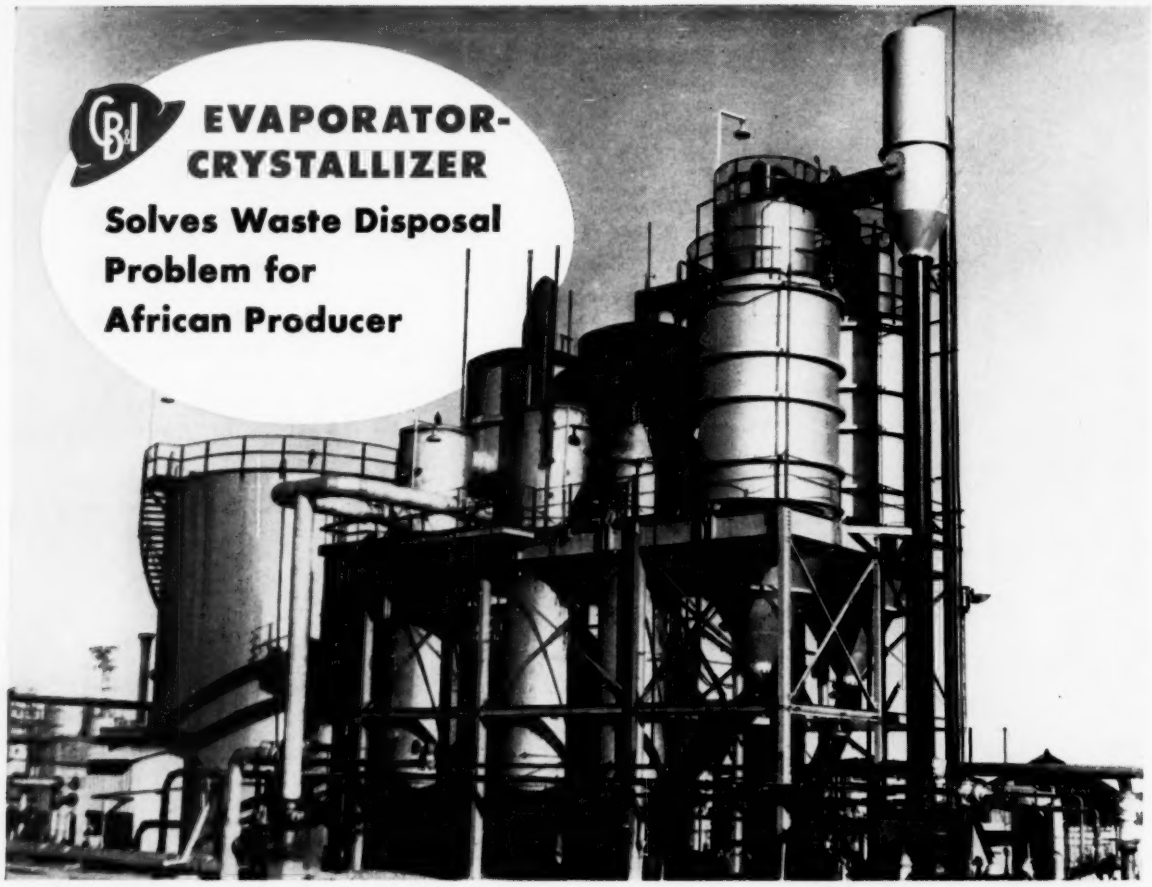
Now dialysis can do more

Plants & facilities, 1959

Water vs. air as a cooling medium

Longer life for centrifugal pumps

SEE PAGE THREE



EVAPORATOR-CRYSTALLIZER

Solves Waste Disposal Problem for African Producer

Continuous operation reported where tough scale problem was anticipated

This four-body, triple effect CB&I Evaporator-Crystallizer was put to work by the South African Coal, Oil & Gas Corporation to process an effluent waste plant liquor—and to produce crystallized acetate compounds from it.

In designing the unit, CB&I engineers were careful to provide for ease and expediency of cleaning and service . . . because of the high scaling tendency of the material. In addition, the unit was built to operate under a special large volume recirculation technique designed to inhibit scale formation. After many months of operation, the plant reports that loss in production time for cleaning amounts to only 3%. Due to the serious plant operating problem that exists when the evaporator-crystallizer is down the unit runs continuously, even during cleaning.

This report shows why so many CB&I customers are *repeat* customers. CB&I equipment is engineered and adaptable to the most exacting operating requirements. As a result, CB&I customers are accustomed to turning a *profit* from high, uniform crystal production—at low operating cost. Write our nearest office for further details on CB&I-built evaporators, crystallizers and filters.

Above:
CB&I triple effect evaporator-crystallizer at Coalbrook, South Africa has helped South African Coal, Oil & Gas Corporation to solve a difficult waste disposal problem and to recover crystalline materials which may eventually prove to be a new, marketable product.

C46C

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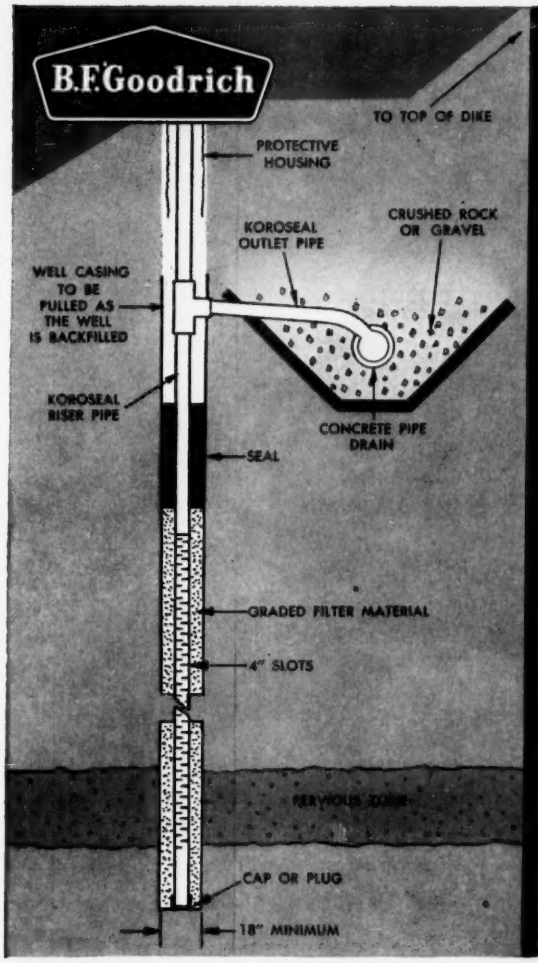
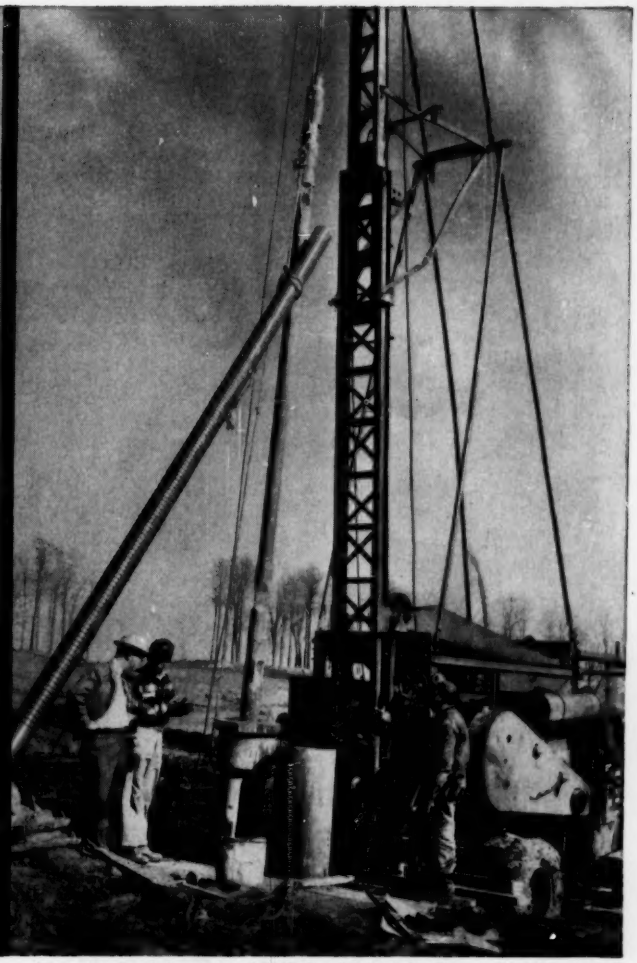


Koroseal PVC pipe relieves hydrostatic pressures under the toe of dikes built along the St. Lawrence Seaway from Waddington, N. Y. to Massena, N. Y. Underground water enters the Koroseal riser pipe through a series of slots. Under pressure, water rises inside pipe and is discharged through Koroseal drainage pipe to natural drainage channels.



Twenty-foot length of B. F. Goodrich rigid Koroseal PVC slotted pipe swings into position for sinking as a relief well. More than 2,000 feet of this Koroseal pipe, known for its resistance to corrosion, taps "pervious zones" beneath dikes and draws off underground water that might otherwise weaken the structures.

B.F.Goodrich Koroseal PVC pipe protects dike system on St. Lawrence Seaway

WHEN gates of the new Long Sault dam and St. Lawrence power dam were closed, a lake extending 35 miles upstream was formed. Dikes, some as high as 85 feet, were built to safeguard the surrounding countryside, including some populated areas which were 40 feet below the lake level.

To protect against excess hydrostatic pressures along the dike toe, 23 relief wells of 6-inch B.F.Goodrich Koroseal PVC pipe were installed to serve as automatic safety valves. These Koroseal relief wells tap "pervious zones" 20 to 50 feet beneath the dikes and draw off underground water that might otherwise undermine embankments.

In this installation, engineers specified Koroseal PVC pipe because of its superior resistance to corrosion and its strength. Koroseal also has high impact resistance and superior insulation qualities. It threads easily, can be cut, welded or drilled. It never needs to be painted, will not support combustion. Koroseal is available in pipe, tubes, rods, valves and sheets. For information, just send in the coupon.

B.F.Goodrich Industrial Products Co.
Dept. CE-5, Marietta, Ohio
Please send me free booklets on:
☐ Rigid Koroseal Pipe
☐ Rigid Koroseal Sheet

Name_____

Company_____

City_____ Zone____ State_____

Koroseal—T. M. Reg. U. S. Pat. Off.

Koroseal pipe slotted and sold by F. C. Nichols, Inc., Norwood, Syracuse and Niagara Falls, New York.

B.F.Goodrich *Koroseal rigid PVC products*

Contents for May 4, 1959

Chemical Engineering

Vol. 66 No. 9

CHEMICAL TECHNOLOGY FOR PROFIT-MINDED ENGINEERS

Wallace F. Traendly, Publisher
Sidney D. Kirkpatrick, Editorial Director

•

John R. Callaham, Editor-in-Chief

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CHEMICAL ENGINEERING DEVELOPMENTS

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CHEMICAL ENGINEERING PRACTICE

* FREE—for your files—Check Reader Service postcard (p. 211) for an extra file copy of this guide to better answers to your estimating problems.

Contents continued . . . turn page

"The Fall of Icarus", by the 18th century illustrator Picart, is an imaginative conception, based on Greek mythology, of space propulsion by muscle power. This interpretation of it by wood engraving is one in a series of similar works undertaken especially for Hercules by Brussel-Smith, noted graphic artist.

IMAGINATION IN SPACE

Since Creation, man has looked out on space. At first, unknowing and incurious; then with the beginnings of understanding; now free and able to explore. Yet to move in space calls for wholly new concepts of energy.

This, then, is the working philosophy of Hercules in chemical propulsion: To design and manufacture highly concentrated packages of energy as propellants and rocket motors; each compatible, controllable, predictable; and each perfected for its specific mission.

HERCULES' BACKGROUND: A half-century of creative imagination in the evolution of propellants, from shotgun powder to space propulsion; encompassing research, design, engineering, and staff organization for the production of the most advanced propellants.

HERCULES POWDER COMPANY
INCORPORATED
900 Market Street, Wilmington 99, Delaware

XP59-1

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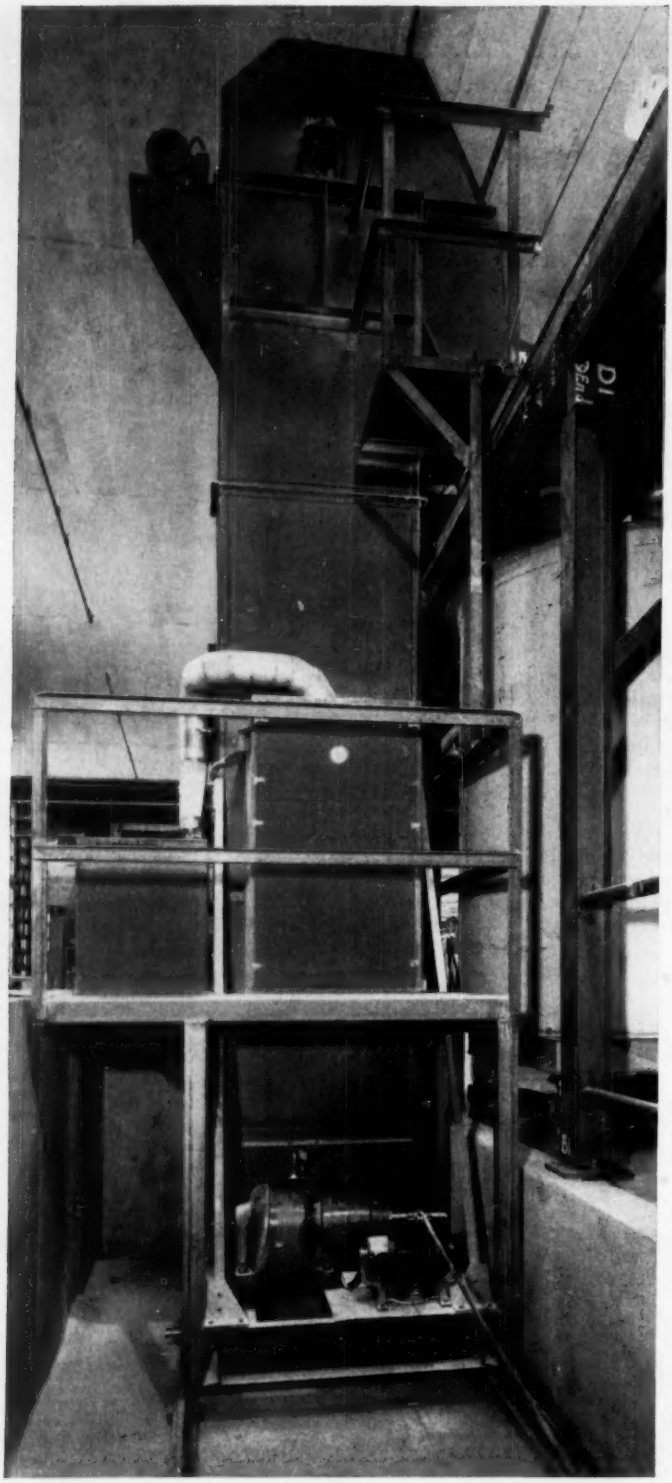
No assembly problems with bucket elevators LARGE or SMALL!



TRAVELING BUCKET ELEVATOR. This Link-Belt centrifugal discharge bucket elevator, mounted on a steel, self-propelled carriage, travels along rails and serves a line of processing tanks.

LINK-BELT makes all elements for bucket elevators

RESULT:
easier installation
smoother performance

If bucket elevator components don't match perfectly, time and effort needed for assembly can send installation costs skyrocketing. And if misalignment isn't corrected, it soon shows up in bucket and casing wear, undue drag and friction, excessive maintenance and downtime.

Integrated Components

Link-Belt prevents these costly installation and operational headaches . . . eliminates them in the *factory*, not in the field. Making *everything that goes into a bucket elevator*, Link-Belt carefully designs, manufactures and integrates all components for perfect, ready alignment. As a result, unnecessary erection costs and difficulties are avoided . . . efficient, long-lasting elevator performance is assured.

One-Source Service

Equally important, the completeness of Link-Belt's line makes it easy to select the proper type bucket elevator and components best suited to your material and capacity requirements. Link-Belt will erect your elevator and accept full installation responsibility. For complete details, contact your nearest Link-Belt office.

LINK-BELT

BUCKET ELEVATORS

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Australia, Marrickville (Sydney); Brazil, Sao Paulo; Canada, Scarboro (Toronto 13); South Africa, Springs. Representatives Throughout the World. 14,917

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exclusive T-BLOCK design doubles life of piston rings on JOY oil-free compressors

All Joy oil-free compressors are equipped with carbon-graphite piston rings of T-block design. They require no lubrication and compensate automatically for wear. Blow-by is virtually eliminated for the life of the ring. Brass expanders and stainless steel springs operating in teflon sleeves provide the piston rings with controlled pressure evenly distributed on the cylinder walls. Result: "bug-free" operation and freedom from corrosion. Compressor owners report ring life of 8000 operating hours, and more.

If your operations require oil-free compressed air, whether for instrumentation or for processing, get complete details from Joy. A complete line of oil-free compressors is available from 95 to 3600 cfm, 15 to 600 hp.

Ask for free bulletin 301-11.

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In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

WSW I 7519-301

EXCLUSIVE SAVINGS

Future savings in vacuum tumble drying can be previewed at P-K's Vacuum Tumble Dryer Pre-Test Laboratory. Pre-testing realistically points the way to economies in drying time, solvent recovery, process simplification and handling costs. It helps gain management and purchase approval. And it permits modification of controls, condenser, vapor line, receiver and other components to the individual needs of your process and product.

EXCLUSIVE COMBINATION!

Only P-K Vacuum Tumble Dryers offer pre-tested, pre-packaged savings. In pre-testing, results are predicted with a detailed procedure report and test samples. In pre-packaging, a single source of responsibility delivers a tailored, thoroughly proved assembly at a cost far less than a do-it-yourself project.

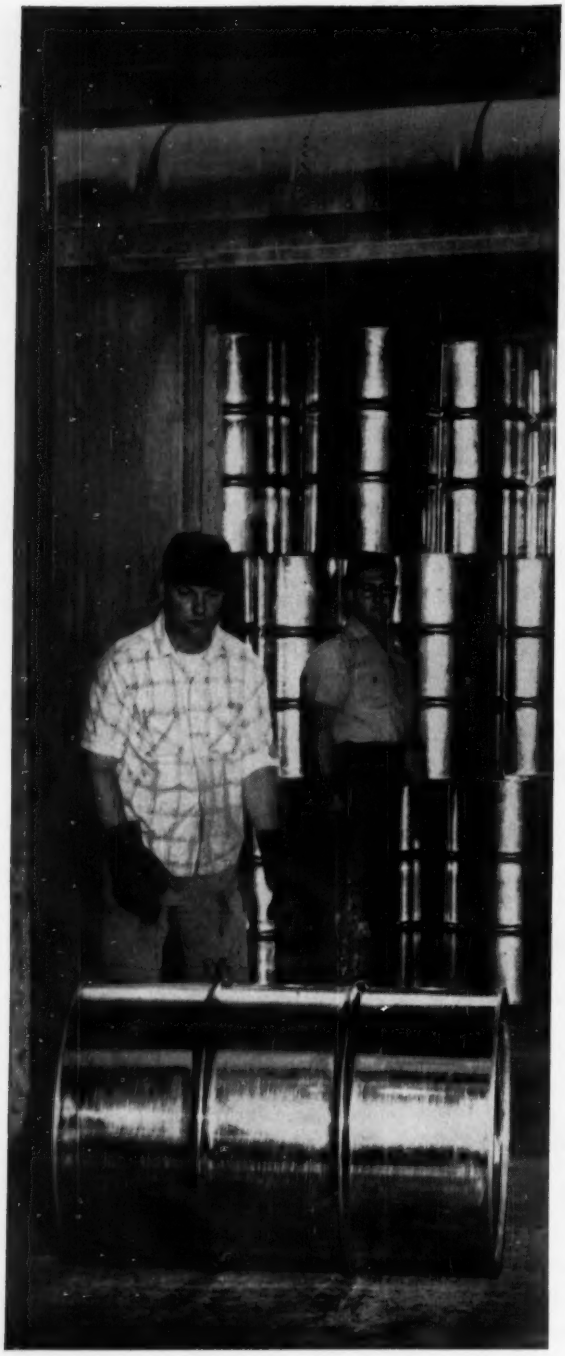
Compared to tray drying, the advantages of P-K Vacuum Tumble Dryers are overwhelming. Drying is many times faster. Expensive solvents are condensed and recovered. And caking that requires separate pulverizing and screening steps is eliminated. This greatly reduces handling. It often saves enough in labor costs to justify investment. It safeguards against product contamination.

In design, too, P-K Vacuum Tumble Dryers offer important features. Typical examples: A series of filter precautions that protect the vacuum pump from solids; an optional pin-studded intensifier that produces extra fine powder during drying.

Why not investigate P-K Vacuum Tumble Dryers more completely? Our pre-test facilities are at your disposal. Send or bring your test material. For complete information mail the coupon or call George Sweitzer at our East Stroudsburg Headquarters, 1505 Hanson Street. 17-B

REPUBLIC STEEL DRUMS

...are strong and safe to protect their contents!



Republic Steel Drums are rugged on the outside, chemically clean on the inside, for protection of their contents under all kinds of conditions. They are available in a wide range of types and sizes, in both light and heavy gage classifications, to provide a complete service to the chemical industry.

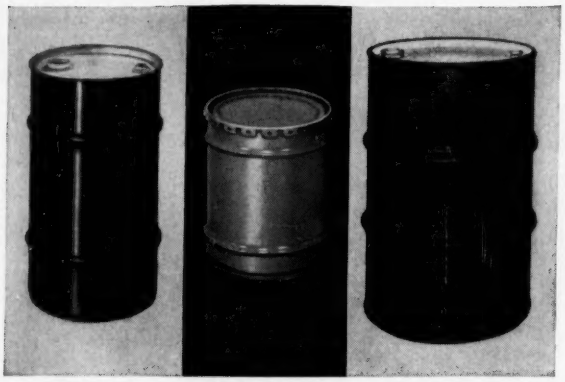
Light Gage Class I.C.C.—17E, 17H, 17C, 6J: Republic offers either tight-end or full-removable head drums as specified. Drum bodies and heads can be decorated to order. High-bake lacquer linings are available, or drums can be hot dip galvanized or hot dip tinned to handle difficult-to-hold materials.

Heavy Gage Class I.C.C.—5, 5A, 5B, 5C, 17F, and certain I.C.C.—6 Series. Drums are available in 55-, 30-, and 20-gallon capacities, from 16- to 12-gage in hot rolled carbon steel, depending on specification and service. As with the light gage service, hot dip galvanizing and hot dip tinning can be provided. In addition, Republic offers containers made of ENDURO® Stainless Steel for the ultimate in long-lasting, trouble-free, corrosion-resistant performance.

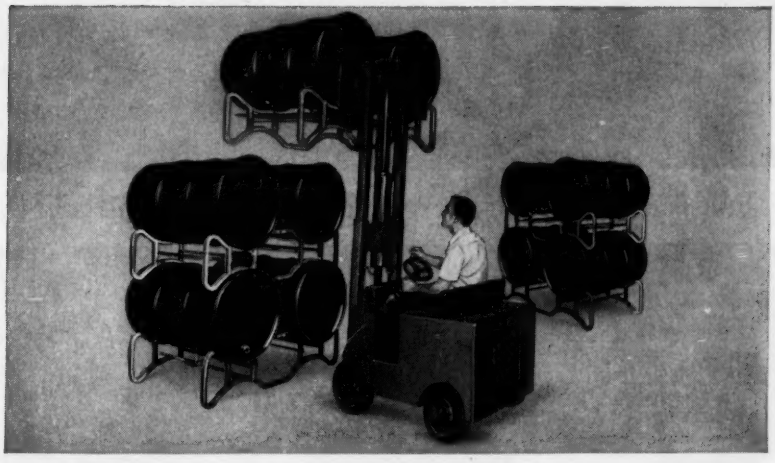
Republic also produces a full line of Steel Packages from 3½- to 20-gallon capacities. Gages range from 26 to 20 in plain steel. Decoration and special high bake linings can be applied to meet individual requirements.

Act now to obtain full information on Republic Steel Drums, and how they can protect your materials. Send coupon at lower right for detailed literature.

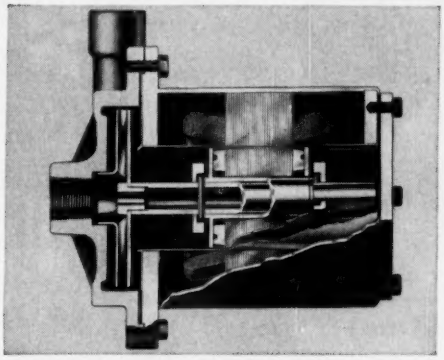
A FEW AVAILABLE TYPES



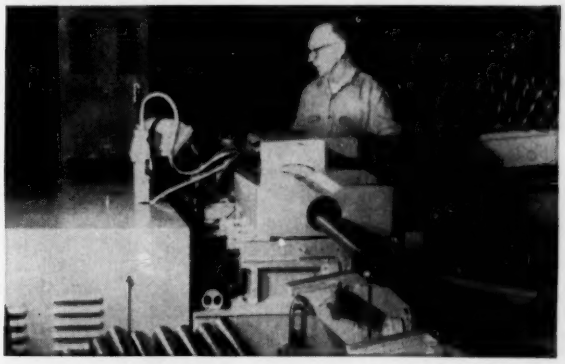
Universal Standard 15- or 16-Gallon Oil Drum | Republic 10-Gallon Lug Cover Drum | I.C.C. 5, 5B, and 17F Heavy Duty Drum



PORTABLE DRUM RACKS shown are exclusive with Republic, and are available at low cost. Each will accommodate two loaded 55-gallon drums, permitting stacking to any practical height to save valuable floor space. Republic Portable Drum Racks are shipped knocked down, with fasteners for quick and easy assembly. Send coupon for details.



REPUBLIC TITANIUM CAN ADD YEARS TO EQUIPMENT LIFE. Maximum corrosion-resistance plus an exceptionally high strength-to-weight ratio are major reasons for its use in this seal-less, leak-proof centrifugal pump made by Chempump Corporation, Philadelphia, Pennsylvania. The pump handles such corrosive liquids as chlorine dioxide. All wetted parts are made from Titanium. Chempump's exclusive design makes it possible and *economical* to use Titanium for these vital parts. Mail coupon today for more facts on Republic Titanium.



POSITIVE MEASUREMENT OF QUALITY can now assure you of the dependability of Republic ELECTRUNITE® Heat Exchanger Tubes. Now you can specify FARROW-TEST®, a production method of electronic testing, as an alternative to other less positive tests . . . *at no extra cost!* ELECTRUNITE Carbon and Stainless Heat Exchanger Tubes are produced from highest quality flat-rolled steel, electronically welded by an exclusive process that unites the tube under pressure without the addition of foreign metal. This process assures uniformity, strength, ductility, concentricity, and other physical properties to meet critical performance specifications. For additional facts on Republic ELECTRUNITE Heat Exchanger Tubes, mail coupon now.

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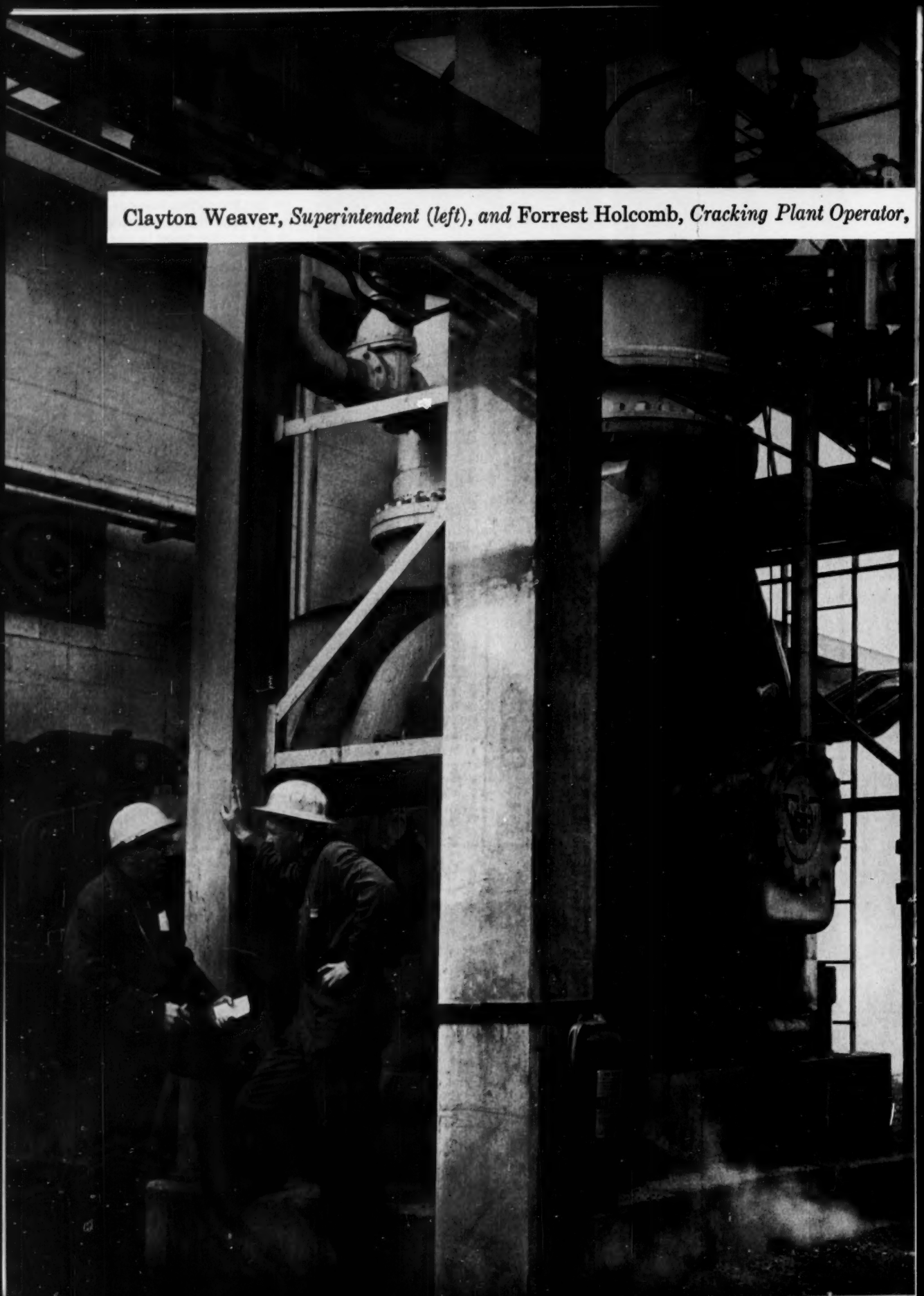

Clayton Weaver, *Superintendent (left), and* Forrest Holcomb, *Cracking Plant Operator,*

Leonard Refineries, discuss function of air supply in catalytic cracking and...

How Cooper-Bessemer centrifugal compressor supplies big-volume air 'round-the-clock

As "Doc" Weaver, Superintendent of Leonard Refineries, Inc., Alma, Michigan explains . . ."Big centrifugals are the answer, of course, where modern processing calls for an extremely dependable air or gas supply at high volume and relatively low pressure. For example, our catalytic cracking requires this kind of air supply for burning coke off the catalyst. Our Cooper-Bessemer Type RS Centrifugal Compressor delivers 31,500 cfm at 30 psi discharge pressure. And, it produces this flow on a continuous, 24-hour basis. We are mighty pleased with its reliable performance."

Find out how Cooper-Bessemer Centrifugal Compressors can help solve *your* processing, air supply or compression problems for optimum economy. There is a type and size of unit for every need. Call our nearest office for complete details.

Cooper-Bessemer Centrifugal Compressors are available in multi-stage type for volumes up to 100,000 cfm . . . in barrel type for air or gas supply at pressures up to 5000 psi. Also in pipeline boosters in ratings up to 20,000 bhp. Shown above: Cooper-Bessemer barrel type centrifugal compressor.

BRANCH OFFICES: Grove City • New York • Washington • Gloucester • Chicago Minneapolis • St. Louis • Kansas City • Tulsa • New Orleans • Shreveport • Houston Greggton • Dallas • Odessa • Pampa • Casper • Seattle • San Francisco • Los Angeles

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Cooper Bessemer

GENERAL OFFICES: MOUNT VERNON, OHIO

ENGINES: GAS - DIESEL - GAS-DIESEL
COMPRESSORS: RECIPROCATING AND CENTRIFUGAL, ENGINE OR MOTOR DRIVEN

Fred Wheelwright, Manager, Industrial Sales: "One of the most pressing problems in industry today is upgrading processing efficiency. It's one of our specialties here at De Laval, and we go at it with a triple punch: outstanding engineering staff, the most complete processing pilot plant in the country, and a full line of outstanding process equipment.

"There are cases where it is relatively easy . . . replacing more traditional processing methods with modern, high speed and high capacity process equipment. Sometimes, it's only a part of the process that needs improving; in other cases, our engineering staff has developed a whole new system (De Laval's patented Tall Oil Process is a case in point.)

"But whatever the problem . . . in heating or cooling, separation or recovery . . . we've found that we can almost always increase processing efficiency through careful selection of exactly the right process equipment. Why not let us work on your processing problems? Just drop us a line about them on your letterhead. No obligation, of course."

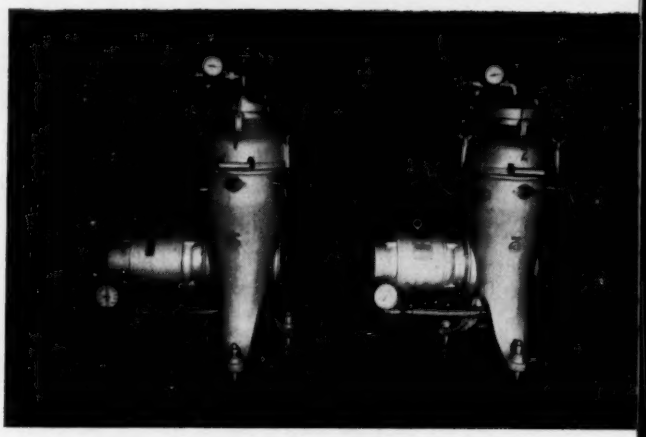
For further information, write to De Laval.

DE LAVAL

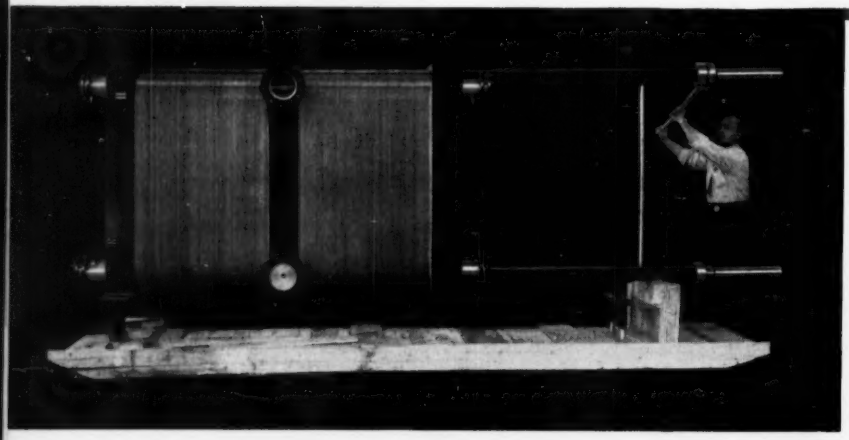
Dept. C-3

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York
5724 N. Pulaski, Chicago 46, Illinois

DE LAVAL PACIFIC COMPANY
201 E. Millbrae Avenue, Millbrae, California



THREE CRITICAL SOLVED WITH



LATEX PROCESSOR HAD A STICKY PROBLEM WITH A HOT SOLUTION

Problem: To heat a solution of 45% Latex concentration from 117°F to 170°F without precipitating excessive coagulum.

Solution: De Laval Plate Heat Exchanger. Shell & Tube exchangers could not be used; they'd be impossible to clean. Instead, this company installed a two section De Laval Plate Heat Exchanger, each section handling 114,500 pounds per hour of the latex concentration. With Type 316 stainless steel plates and a total heat transfer surface of 1,090 sq. feet, the unit has been in operation (and operating perfectly) for almost two years.

Even in processing of a solution as sticky as latex, the De Laval Plate Heat Exchanger is cleaned *in place* by circulation of a cleaning solution immediately following the heating of the latex. For periodic cleaning other than by circulation, the plate pack is easily opened. All heat transfer surfaces are immediately exposed for manual cleaning with a minimum of trouble.

HOW PILOT TESTS LICKED CORROSION PROBLEMS IN EPOXY RESIN PROCESSING

Problem: In extracting epoxy resin from vegetable oil, our customer needed equipment that would successfully separate the resin from the highly corrosive reaction mixture and do so without aeration.
Solution: De Laval Model S-194 Hermetic Centrifuges. Like all answers, this one seems easy after it is known. But in order to determine exactly what equipment would satisfy our customer's needs, we ran extensive tests in our full scale pilot plant. As a result of the pilot operations, two S-194 Hermetic centrifuges were installed, each operating at a capacity of 1000 gph. All parts coming in contact with the corrosive liquid are of Type 316 stainless steel.

These machines have been in full scale, successful operation for better than two years; since then, there has been no problem whatsoever with corrosion, aeration, or any other aspect of the process.

When you're developing a new process, or adapting an existing process, remember that De Laval's engineering staff and full scale pilot plant are at your service to help you determine the most efficient, highest capacity processing equipment for your own specialized needs.

PROBLEMS...
DE LAVAL PROCESS EQUIPMENT

CENTRIFUGES • PLATE HEAT EXCHANGERS • VIBRATING SCREENS • COMPLETE PROCESSES

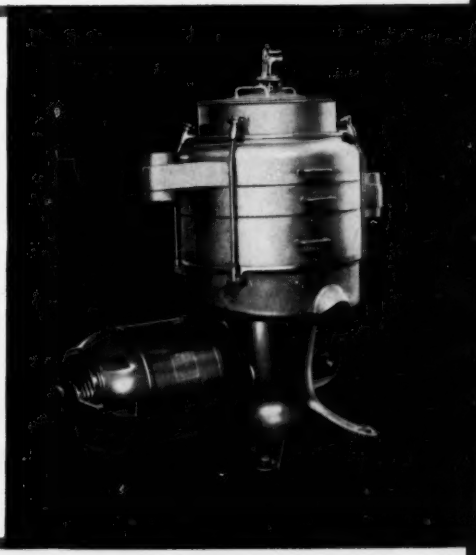
GETTING RID OF THE BUGS IN ANTIBIOTICS PROCESSING

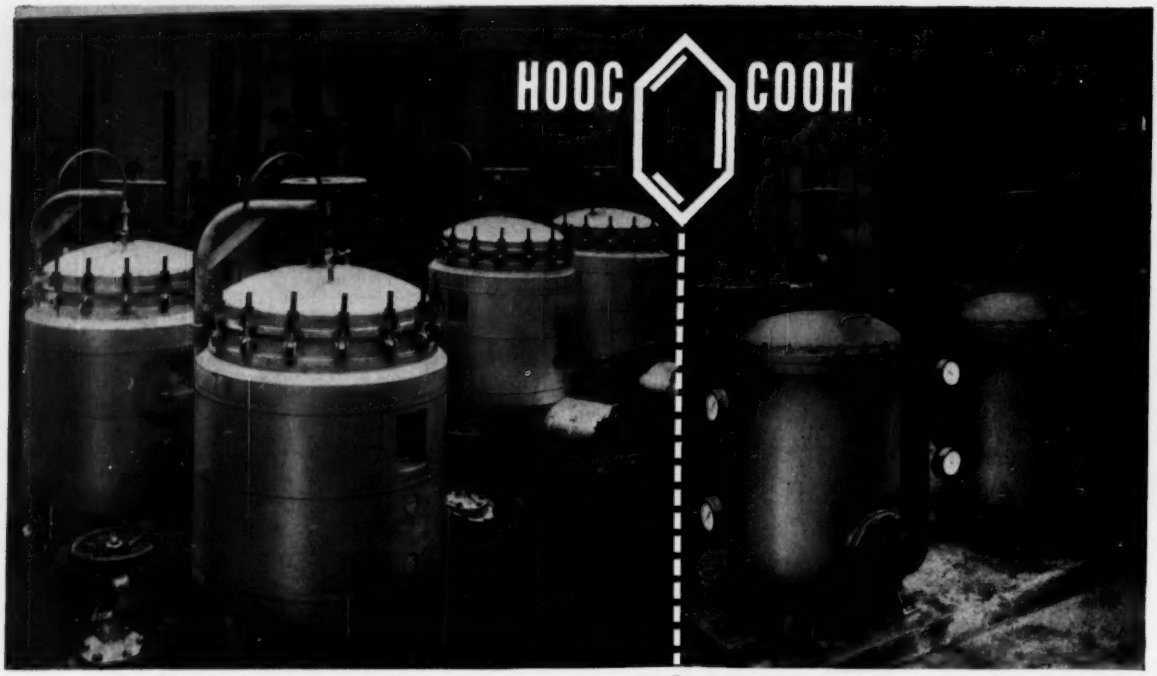
During World War II, our customer had installed a battery of all-stainless centrifuges for production of antibiotics. They had been in full scale operation ever since.

Problem: After fifteen years with the original machines, the processor felt the need for greater processing efficiency, higher capacities, and the elimination of shut-down for manual cleaning of the centrifuge bowls.

Solution: The De Laval AC-VO-3 "Nozzle-Matic." One of these machines replaces three of the earlier centrifuges, running five days per week (24-hours per day) on a non-stop production basis. Since the bowl is equipped with nozzles built right into the bowl wall, solids are discharged continuously while the machine is operating at full speed. Liquid effluent is discharged from its own outlet, and the machine need never be stopped for manual cleaning.

What about your own processing operation? If you could benefit from greater efficiency and higher capacities, it might well pay you to investigate updating your process with De Laval Process Equipment.





How CFC FILTERS assure micro-clarity of Oronite Isophthalic

(Left) These stainless steel CFC Flo-Pac Filters remove micronic particles from the process stream in the production of Oronite Isophthalic.

(Above) Fulflo Filters, each containing 110 Honeycomb Filter Tubes, provide micro-clarity of reaction streams used in processing Oronite Isophthalic.

Isophthalic, one of the most important raw materials developed for the protective coating and plastics industries, gives outstanding new qualities to paints, baking finishes, polyesters, polyamides, plastics and plasticizers. Oronite Chemical Company, a subsidiary of Standard Oil Company of California, assures absolute clarity of Isophthalic with CFC Filters.

Oronite makes good use of both surface and depth filtration. The CFC Flo-Pac Filter provides surface filtration in removing impurities as small as 5 microns in size. Tough resin-impregnated pleated paper cartridges each have more than 6300 square inches of filtering surface.

CFC Fulflo Filters, with genuine Honeycomb Filter Tubes, give true *depth* filtration through hundreds of filtering tunnels engineered for uniformity of size, shape, depth and density.

Fulflo Filters provide any degree of micro-clarity (down to 1 micron) for all types of petrochemicals, liquid chemicals, pharmaceuticals, oils, liquid fuels, water, compressed air, other gases.

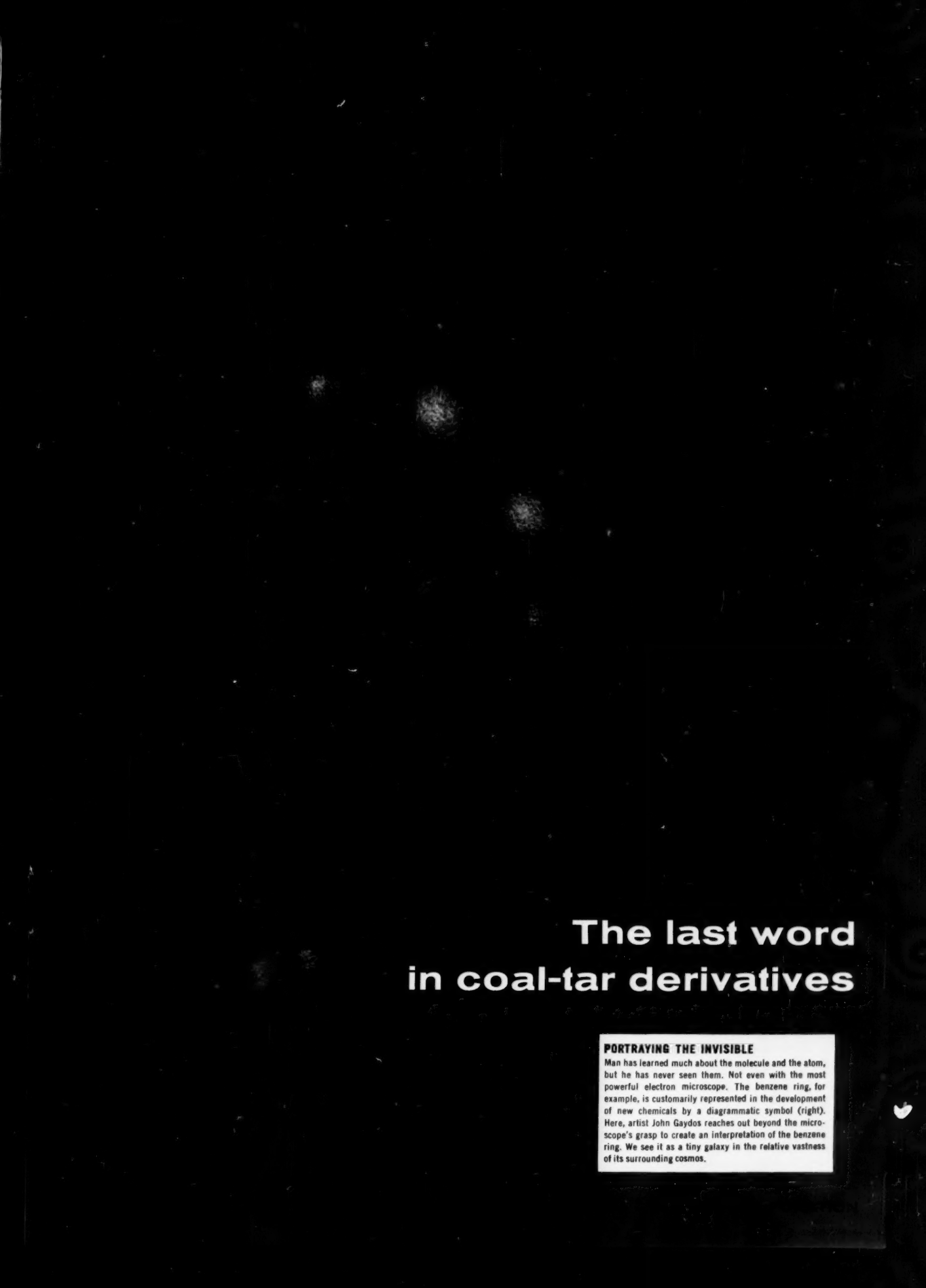
Look to CFC Filters — to improve product quality, reduce downtime, and cut production costs. *Write for technical literature or engineering assistance to Dep't CE*

COMMERCIAL FILTERS CORPORATION
MELROSE 76, MASSACHUSETTS
PLANTS IN MELROSE, MASSACHUSETTS AND LEBANON, INDIANA

MICRO-CLARITY AT MINIMUM COST

Fulflo FILTERS — *with genuine Honeycomb Filter Tubes for controlled micro-clarity of industrial fluids.*

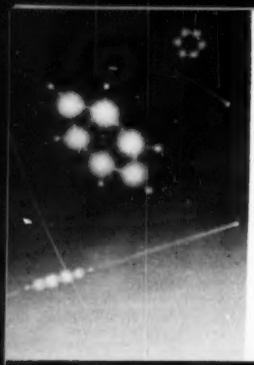
CFC FILTERS — *Selective filtration of oils • water-oil separators • magnetic separators • pre-coat filters • coolant clarifiers • automatic tubular conveyors.*



The last word in coal-tar derivatives

PORTRAYING THE INVISIBLE

Man has learned much about the molecule and the atom, but he has never seen them. Not even with the most powerful electron microscope. The benzene ring, for example, is customarily represented in the development of new chemicals by a diagrammatic symbol (right). Here, artist John Gaydos reaches out beyond the microscope's grasp to create an interpretation of the benzene ring. We see it as a tiny galaxy in the relative vastness of its surrounding cosmos.



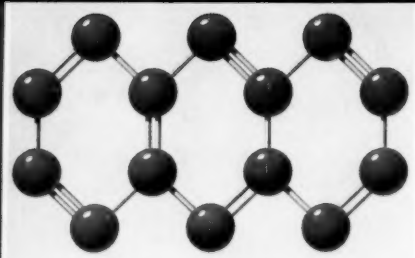
Long established as a major branch of the chemical complex, coal tar derived chemicals continue to offer attractive opportunities to development chemists and process engineers alike. Some of the chemicals described on these pages are commercially new—and

ELASTEX® PLASTICIZERS

Plastics and Coal Chemicals Division can control the quality of "ELASTEX" Plasticizers, because they are manufactured from Allied Chemical's basic materials. Plasticizers which are liquid in form can be shipped to you by express tank truck from any of 12 key cities.

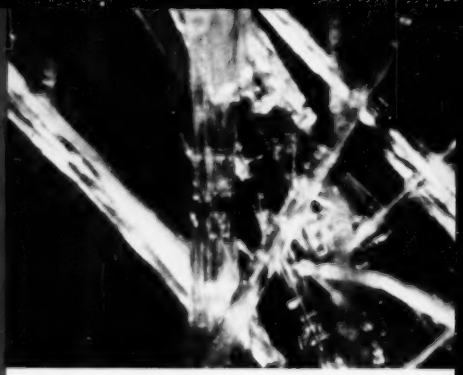
Dimethyl Phthalate*
Dibutyl Phthalate*
"ELASTEX" DCHP Plasticizer—Dicyclohexyl Phthalate
"ELASTEX" 10-P Plasticizer*—(Diisooctyl Phthalate) (DIOP)
"ELASTEX" 28-P Plasticizer*—Di-2-Ethylhexyl Phthalate (DOP)
"ELASTEX" 18-P Plasticizer*—Isooctyl Isodecyl Phthalate
"ELASTEX" 20-A Plasticizer*—Diisodecyl Adipate
"ELASTEX" 40-P Plasticizer*—Butyl Isodecyl Phthalate
"ELASTEX" 48-P Plasticizer*—Butyl Octyl Phthalate
"ELASTEX" 50-B Plasticizer*—Butyl Cyclohexyl Phthalate
"ELASTEX" 60-A Plasticizer*—Di-2-Ethylhexyl Adipate
"ELASTEX" 82-P Plasticizer*—Normal Octyl-Normal Decyl Phthalate
"ELASTEX" 90-P Plasticizer*—Diisodecyl Phthalate (DIDP)
"ELASTEX" 36-R Plasticizer—Medium molecular weight polymeric plasticizer
"ELASTEX" 37-R Plasticizer—High molecular weight polymeric plasticizer
Plasticizer 136*—An aryl alkyl hydrocarbon
* Available in Tank Cars and Trucks

ANTHRACENE



A well-known coal-tar constituent, anthracene is now available commercially from a domestic source. It has already found application as an intermediate in the manufacture of anthraquinone dyes. It undergoes both the Diels Alder and Friedel-Crafts reactions . . . can be reduced, nitrated, sulfonated and reacted with halogens . . . has remarkable photosensitive properties. Anthracene may prove an attractive starting point for materials now being produced by other methods. And it may open commercial possibilities for derivatives of yet undetermined potential.

ALLIED CHEMICAL PHTHALIC ANHYDRIDE



This crystal, magnified 100 times, is phthalic anhydride—starting material for alkyd resins, plasticizers, polyesters and a host of chemicals and pharmaceuticals. As the largest producer of phthalic anhydride, Plastics and Coal Chemicals Division has pioneered in development and standardization. A new standard of purity for Allied Chemical Phthalic Anhydride was recently announced, establishing its purity at 99.7 mole per cent minimum.

ACETOPHENONE

($C_6H_5COCH_3$)

A valuable intermediate, acetophenone is used in the manufacture of drugs, resins, dyestuffs and inks. It is also an effective extraction and process solvent. Its structure, related to many commercially valuable organics, suggests an excellent potential in synthesis applications.

ETHYL-BENZENE

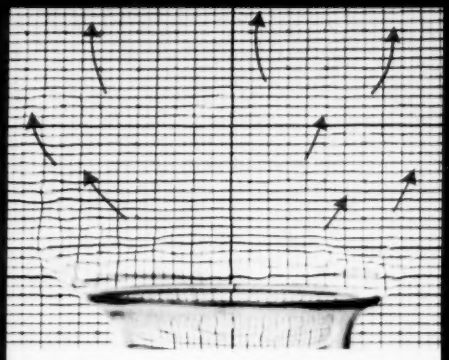
($C_6H_5CH_2CH_3$)

Though its principal use is the manufacture of styrene monomer, ethylbenzene is finding growing applications as an intermediate in organic synthesis and the production of synthetic dyestuffs. It is also a solvent for synthetic resins and a diluent for lacquers. It can be used as a heat-transfer medium and as a dielectric.

PLASTICS AND COAL CHEMICALS DIVISION

you may be the first to exploit them. Others are recognized staples of chemical processing, included here to acquaint you with the growing line of the world's largest producer of coal-tar chemicals ... Plastics and Coal Chemicals Division of Allied Chemical.

ALLIED CHEMICAL INDUSTRIAL AROMATIC SOLVENTS



Plastics and Coal Chemicals Division has led the way in establishing standard testing methods and specifications for light oil distillates. This work has paid off in the higher reliability of Allied Chemical Aromatic Solvents.

Benzol, Nitration	Xylol, Nitration
Benzol, Industrial Pure	Xylol, Ten Degree
Benzol, Industrial, 90%	Xylol, Industrial
Benzene, Thiophene-free	Hi-Flash Solvent
Toluol, Nitration	1320 Oil
Toluol, Industrial Pure	Wire Enamel Solvent

All available in Tank Cars and Tank Trucks

ALLIED CHEMICAL TAR BASES

This special class of refined coal chemicals includes pyridine, quinoline and related compounds. Recent developments indicate that their potentials in the field of industrial chemistry are just beginning to be realized.

Refined Pyridine 2A
Pyridine 10A
Pyridine 15A
Mixed Picolines 20A
Pyridine 30A
Mixed Lutidines
Tar Bases 50A
Refined Alpha Picoline 2A
Refined Beta Gamma Picoline
Refined Quinoline
Refined 2, 4 Lutidine
Special Refined Grades
Special Fractions

ALLIED CHEMICAL TAR ACIDS AND TAR ACID OILS

The phenols obtained from coal-tar distillates comprise a valuable group of manufacturing chemicals—the tar acids. Among them, you are likely to find acids to the exact degree of refinement you require. Tar Acid Oils are blends of tar acids and coal-tar neutral oils, selected to give varying phenol coefficiency and ready emulsifiability.

Phenols
Phenol USP, Synthetic
Technical Phenol (all grades)
Phenol-Cresol Mixes
Phenol-Cresylic Mixes

Cresols
Cresol, USP
Ortho Cresol (ranging from 50% to 98+% purity)
Metaparacresols
Resin Cresols
Special Cresol Fractions blended to order

Cresylic Acids
Mixtures of close-cut fractions blended to meet particular commercial requirements
Special Engine Cleaning Grades

Xylenols
Metaxylenol—45°C., 56°C and 61.2°C. Min. M.P.
Crude and Refined Grades
Special Fractions

Tar Acid Oils
Percentage of Tar Acids ranging from 10 to 50.

PHTHALONITRILE

Above is a diagram of the phthalocyanine molecule, formed by a ring of four phthalonitrile molecules around a central atom of copper or some other metal. Starting with phthalonitrile, you can produce phthalocyanine dyes or a host of other new compounds deserving investigation. Since phthalonitrile is now available, developments involving it can be put to immediately profitable use.

ALLIED CHEMICAL CORPORATION

Get the last word in coal-tar derivatives

For the convenience of purchasing people in specific chemical industries, we have compiled helpful product data on an industry-by-industry basis. You can have this data by filling out the coupon below, telling us what industry you're working in. You'll find it an important assist in keeping all our resources at your fingertips.

PLASTICS AND COAL CHEMICALS DIVISION
40 Rector Street, New York 6, N. Y.
In Canada: Allied Chemical Canada, Ltd., 1450 City Councillors St., Montreal

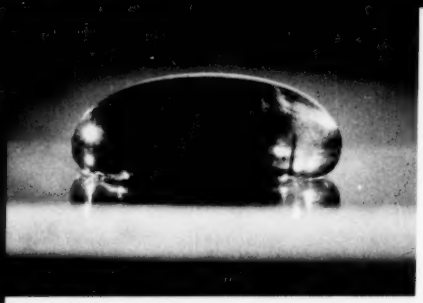
Allied Chemical

ALLIED CHEMICAL NAPHTHALENE

Comes in six convenient forms: ball, flake, ring, chipped, crushed and liquid. Suits requirements for insecticides, tanning agents, dyestuff intermediates, pharmaceuticals, phthalic anhydride and other industrial chemicals. Crude naphthalene also available in tank cars and tank trucks.

ALLIED CHEMICAL NIACIN USP

The finest Niacin available, specifically intended for pharmaceuticals, animal and poultry feeds and the enrichment of flour. Blends with soy flour available for the manufacture of vitamin premixes. Produced to meet the highest standard of purity through basic position in raw materials and the most modern equipment—conforms to USP specifications. Can be ordered from our manufacturing plant in Philadelphia and warehouses at Los Angeles and Chicago.



CUMAR® RESINS

One of the earliest developments in synthetic resins, these paracoumarone-indene resins continue to find broad markets in a dozen industries. They are available in nine separate grades for use in varnishes, floor tile, natural and synthetic rubber products, printing ink, adhesives and waterproofing materials. They are also used in the leather, electrical, radio, and paper industries.

OTHER CHEMICALS AND PRODUCTS OFFERED BY THE PLASTICS AND COAL CHEMICALS DIVISION

- Maleic Anhydride
- Fumaric Acid
- Resin S (A neutral synthetic resin of high styrene content)
- Specialized Rubber Compounding Materials
- "A-C" Polyethylene Lubricants
- Acetone
- Ethylene Glycol
- Diethylene Glycol
- Monoethanolamine
- Diethanolamine
- Triethanolamine
- Flotation Agents
- Pickling Inhibitors
- Tar Distillates

CUMENE

Though used principally in the manufacture of phenol, cumene can be employed in the production of alpha methyl styrene by catalytic dehydrogenation . . . as a constituent of aviation gasoline . . . and in other areas of chemical synthesis.

CUMYL PHENOL

This high-purity aromatic has interesting potential as an intermediate. It has been used to produce synthetic resins, insecticides and lubricating oil additives. Like so many commercial aromatics, cumyl phenol poses a challenge to development chemists.

PLASTICS AND COAL CHEMICALS DIVISION,
Allied Chemical Corp., 40 Rector Street, New York 6, N. Y.

Please send me specific product data for:

☐ Rubber Industry ☐ Paint Industry

☐ Plastics Industry ☐ Soap and Specialties Industry

☐ Technical data and laboratory samples

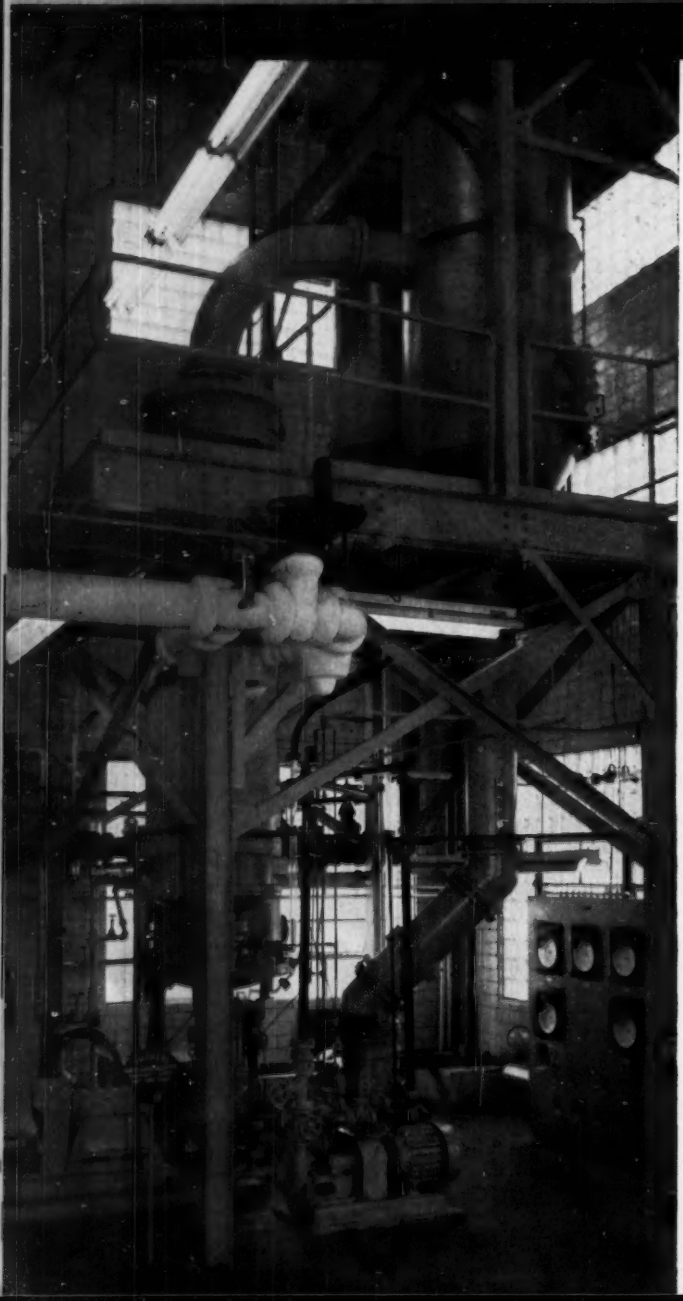
of_____for investigation.

NAME_____

POSITION_____

COMPANY_____

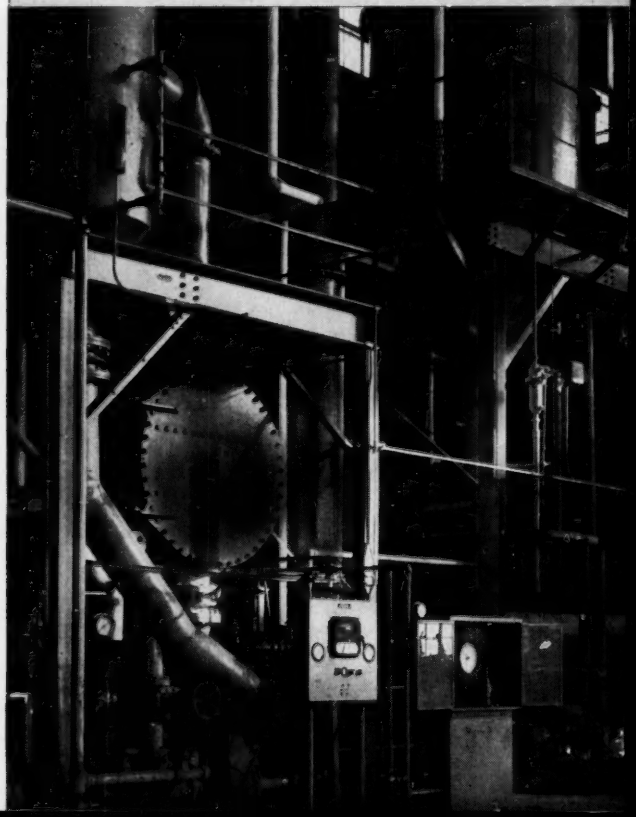
ADDRESS_____

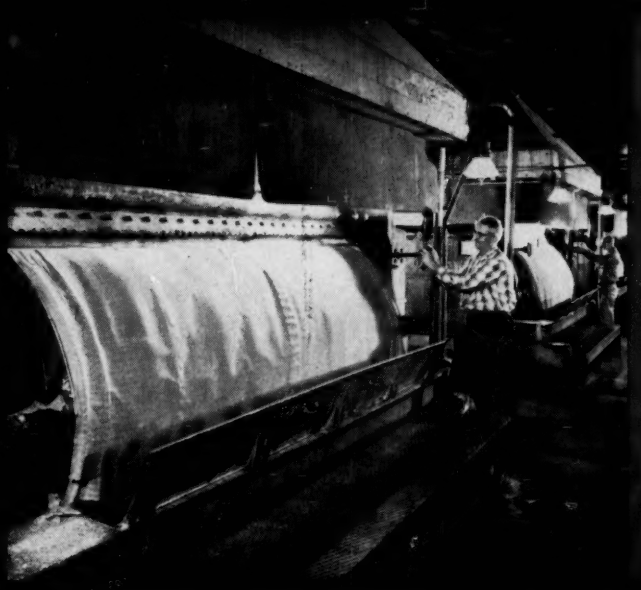


Twin Coach Aircraft Division controls this metal bonding autoclave entirely automatically. Quick Opening Doors speed operation.

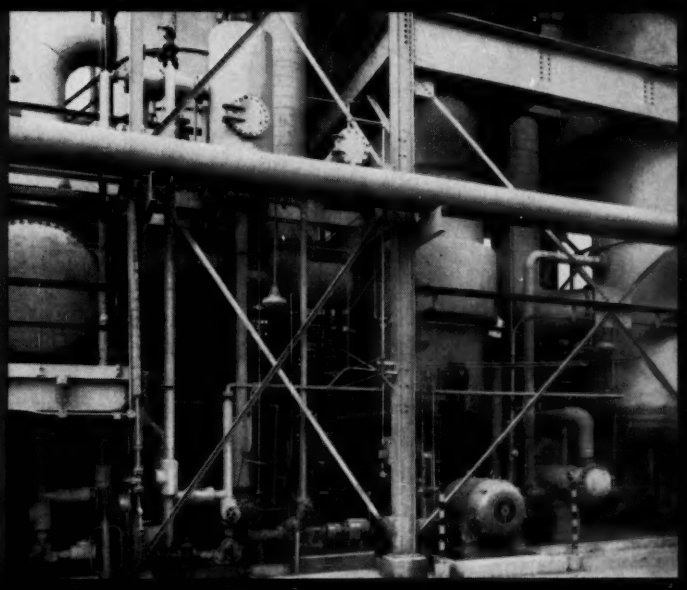
Hercules Powder uses an acid resistant, forced circulation evaporator to concentrate highly corrosive protein solution.

Fish Products utilizes two evaporators to recover vitamins and protein solids from fish oil waste.





National Distillers produces livestock and poultry feed from distillery grain residue by continuous drying with Buflovak double-drum dryers.



Shell Chemical gets dependable glycerine concentration using less power with combination forced and vertical concentration evaporators.

Buflovak engineering pays off for progressive processors

Buflovak research solves the toughest processing problems

Buflovak has the best equipped laboratory for analyzing problems in drying, evaporation, extraction, solvent recovery crystallization and food engineering. Products can be tested by the beakerful or run in carload lots on a full production schedule. Over 7,000 tests have proven for hundreds of companies that product research is the sure way to profits.

Skilled engineering provides the right equipment for the job

Because the line is complete, Buflovak engineers can impartially recommend the right equipment to meet specific job requirements . . . basing their selection on known specifications, or on the results of special research. Whenever custom units are needed, Buflovak has the design know-how and production facilities to follow through.

Industry's most modern units upgrade products, improve operations

Dryers, evaporators, flakers, autoclaves, kettles . . . all the units in Buflovak line incorporate advanced design features developed by extensive product research. On schedule delivery . . . superior performance . . . low operating costs . . . and capable, available service are all part of the Buflovak program to build customer profit.

Send for Catalog 380:
"Buflovak Processing Equipment"

BLAW-KNOX

BLAW-KNOX COMPANY

Buflovak Equipment Division
1551 Fillmore Avenue, Buffalo 11, N.Y.

INSTALL PERFORMANCE NOT PROMISES

Promised catalog ratings and actual on the job ratings are not always the same. When you install "Buffalo" Fans you can always be sure that fan *performance* will confirm your good judgment. Buffalo Forge Company's 81 year reputation for highest engineering and manufacturing standards is assurance that you will obtain fan performance to meet the *exact* requirements of each job.

FOR HIGH PRESSURE REQUIREMENTS:

Designed especially for Class III and IV construction, the "Buffalo" Type "BLH" fan will provide peak performance for your high pressure systems. It affords a mechanical efficiency of 86% over a wide range, while maintaining stability of performance from free delivery to shutoff. The "BLH" features a smooth inlet bell, directional inlet vanes, backward-curved blades and divergent outlet. These factors reduce turbulence to a minimum, and give very quiet operation. An added feature is the non-overloading characteristic. Bulletin F-201 gives complete details.

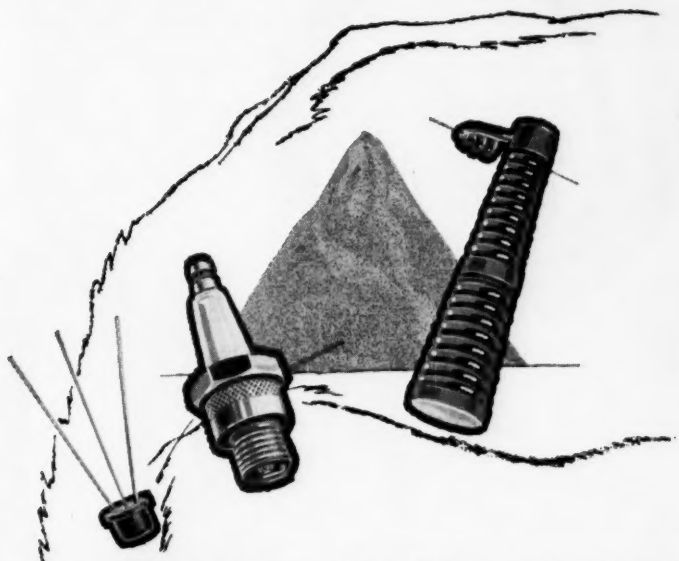
FOR MODERATE PRESSURE REQUIREMENTS:

The "Buffalo" Type "BL" Fan is an ideal choice for your Class I and II ventilating and air conditioning installations. Its high static efficiency over a broad range has been proved in hundreds of applications. The "BL" has many of the unique "Buffalo" features of the "BLH": it is non-overloading, and is designed for minimum turbulence and ultra-quiet operation. Other features are the factory-balanced wheel to minimize vibration and the wheel-contoured housing with large, correctly-shaped scroll. Write for Bulletin F-104.

Only "Buffalo" offers you the "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.

BUFFALO FORGE COMPANY
Buffalo, N. Y.
Buffalo Pumps Division • Buffalo, N. Y.
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT • EXHAUSTING
FORCED DRAFT • COOLING • HEATING • PRESSURE BLOWING



Here are the "basic ingredients" in some of today's most advanced design concepts . . . Norton Ceramic Materials. Exceptionally versatile, these exciting materials are meeting operating requirements of products and processes across industry.

Norton Ceramic Materials offer design engineers a wide range of outstanding physical, chemical, thermal, and electrical properties. What's more, they provide interesting *combinations* of these properties. For example: CRYSTOLON* silicon carbide provides high thermal conductivity as well as exceptional thermal strength; ALUNDUM* aluminum oxide has excellent chemical stability in addition to good abrasion resistance; MAGNORITE* magnesium oxide offers high purity, thermal and electrical resistance; fused

Dynamic Ideas in Engineering . . .

thrive on Norton ceramic materials

zirconium oxide is today's highest melting point material available in tonnage quantities and it's immune to both reducing and oxidizing atmospheres. And each product has *many* other invaluable properties.

Think of Norton Ceramic Compositions as essential components in equipment for metal and chemical processing, electrical, electronic, ceramic and nuclear applications . . . as "the answer" to literally hundreds of design problems. They're manufactured to meet highly exacting standards of purity, density, shape, size and wear resistance . . . available in granular and in fabricated form to meet *your* requirements efficiently and economically. For complete details, write for "Norton REFRACTORY GRAIN". NORTON COMPANY, Refractories Division, 504 New Bond Street, Worcester 6, Mass.

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries

NORTON

REFRACTORIES

Engineered... Rx ...Prescribed

Making better products . . . to make your products better

NORTON PRODUCTS Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electrochemicals — **BEHR-MANNING DIVISION** Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

Case Type No. 1279.

Case Type No. 1379 is Alumalife, while similar case Type No. 1079 is Cast Iron.

Case Type No. 1377.

In such cases DURAGAUGES® naturally serve longer

You have a choice of three case materials—Alumalife®, a special aluminum alloy, Cast Iron, rugged and durable, Phenol, tough and rigid plastic—plus the unique "Maxisafe" design when you specify Ashcroft Duragauges.

All three case materials use a chrome plated, die-cast retaining ring to keep out harmful fumes and dirt. Case construction simplifies servicing—the entire system can be easily removed for recalibration or repair.

The "Maxisafe" case provides absolute protection to the viewer, easy and quick access to the tube and movement assembly. An integrally cast solid wall separates the dial from the tube and movement. A safety cover plate on the back is held in position by a knurled knob.

Regardless of your gauge case requirements, there's an Ashcroft Duraguage to do the job. Contact your local Ashcroft Gauge Distributor for complete facts.

Ashcroft Duragauges are available in pressure ranges from 15 psi (or vacuum) minimum to 100,000 psi.

CASE MATERIALS, TYPE NUMBERS, MOUNTING AND SIZES

CASE	TYPE NO.	BACK FLANGE	MOUNTING		CONNECTION		DIAL SIZE
			WALL	FLUSH	LOWER	BACK	
Black Alumalife	1379	Yes	Yes	Yes	Yes	Yes	4½", 6"
Black Cast Iron	1079	Yes	Yes	Yes	Yes	Yes	4½", 6", 8½" 10", 12"
Black Phenol, Turret Design	1279	No	Yes	Yes*	Yes	Yes	4½", 6", 8½"
Black Alumalife**	1377	No	No	Yes	No	Yes	4½", 6", 8½" 10", 12"

**May be flush mounted by using Flush Mounting Ring, Catalog No. 1278.*
***The 10" and 12" dial sizes are made in cast iron only.*

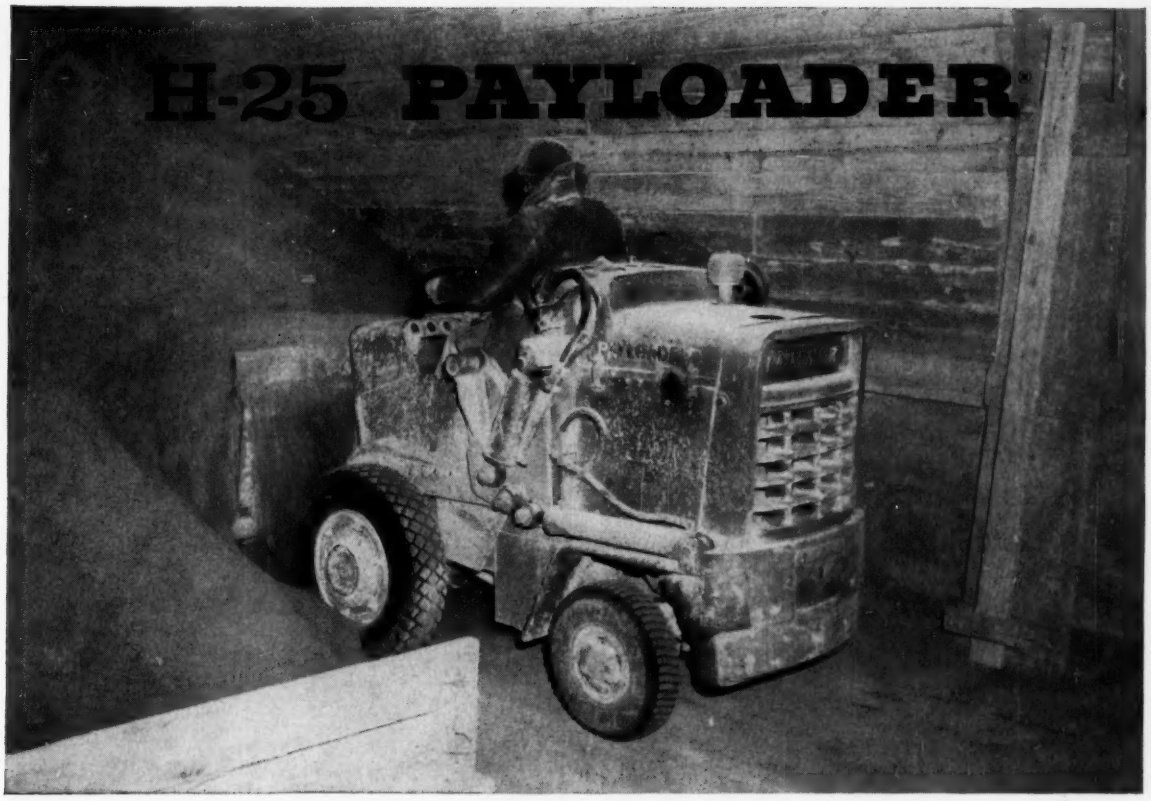
MANNING MAXWELL & MOORE INC. M&M TRADE MARK

ASHCROFT PRESSURE GAUGES

A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario



moves up to 50% more for Virginia-Carolina Chemical Corp.

"On the shipping work the model H-25 does the job previously handled by two model HA's — moves up to ½ as much again as each HA", says Supt. Geo. Eversman, Supt. of V-C's Ft. Wayne, Indiana plant.

"Its ability to dig in extreme hard, compacted material and carry larger loads reduces the number of machines operating in the plant and eases the traffic problem. Repairs have been minor with minor adjustments and a minimum loss of time."

Virginia-Carolina Chemical Corporation has 34 fertilizer plants serving agriculture in 32 states. It has used 'PAYLOADER' units since the first models were built by The Frank G. Hough Co., and also owns one of the largest 'PAYLOADER' fleets. This model H-25 at their Ft. Wayne operation is one of several of these new, more-productive units now serving in their various plants.

There are many reasons why the new Model H-25 will dig, carry and deliver more tonnage with lower operating and maintenance costs than anything in its class. One reason is its 2,500 lb. carry capacity — 500 lbs. more than ever before available with a machine having only 6-ft. turning radius. Greater operating ease, cycling speed and digging power are provided by power-steer, power-shift transmission (no clutching), and 4,500 lbs. of breakout force.

The Model H-25 has extraordinary protection against dust and dirt damage: precleaner and two oil-bath air cleaners; cartridge-type oil filters on the three oil systems; sealed self-adjusting hydraulic service brakes; parking brake enclosed in transmission; special oil and grease seals on all vital points.

HOUGH®

THE FRANK G. HOUGH CO.
LIBERTYVILLE, ILLINOIS
SUBSIDIARY — INTERNATIONAL HARVESTER COMPANY

THE FRANK G. HOUGH CO.
754 Sunnyside Avenue, Libertyville, Illinois

☐ Send data on new H-25 'PAYLOADER' ☐ Other 2-wheel-drive types
☐ Larger 4-wheel-drive types

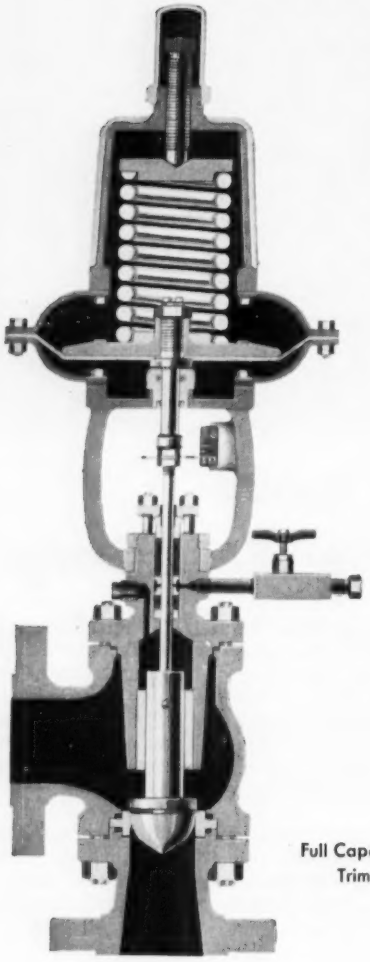
Name.....
Title.....
Company.....
Street.....
City..... State.....

5-A-1

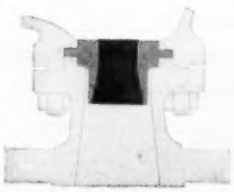
A new and better

ANGLE CONTROL VALVE

. . . for easier maintenance and dependable performance



Full Capacity Trim



40% Capacity Trim

This is a *new* control valve from Honeywell . . . the Type 10 angle valve with body ratings to 600 lbs. Makes piping easier when a valve is needed at a turn. Reduces turbulence and cavitation through an improved venturi effect, when flow is directed to close the valve. And because of the venturi effect, this valve is excellent for slurries, viscous or flashing flow mediums.

CHECK THESE ALL-IN-ONE-VALVE FEATURES:

- **clamped-in seat ring . . .**
  fixed in place . . . gasketed on both sides. Flanged tailpiece permits fast removal, assures good alignment.
- **bolted bonnet . . .**
  allows plug and stem replacement without removing body.
- **flushing connection . . .**
  prevents clogging of guide bushing when slurries are flowing.
- **trim selection . . .**
  full or 40% capacity trim . . . expandable outlets for flashing service.

For further information, contact your local Honeywell field engineer . . . he's as near as your phone. Write for Catalog C800-1. MINNEAPOLIS-HONEYWELL, Fort Washington, Pa.

Honeywell

First in Control

Stainless pressure tubing that gets white glove treatment

IF you're thinking of using stainless steel pressure tubing to solve a problem, make sure you get your money's worth. Timken® stainless steel pressure tubing is so carefully made it's literally handled with white gloves. That's typical of the quality that's built-in every step of the way. And you get this high internal quality and excellent surface finish, because:

1. **THE TIMKEN COMPANY** has one of the most modern, best-equipped seamless tube mills in the country.
2. **WE PIONEERED** in producing stainless steel tubing for pressure tube applications.
3. **MANY TECHNIQUES** we use are virtually unique in the steel industry.

Experts handle every production step—melting, piercing, finishing, testing, final inspection. The result is, you get the finest stainless pressure tubing you can buy. Tubing proved by performance in hundreds of applications.

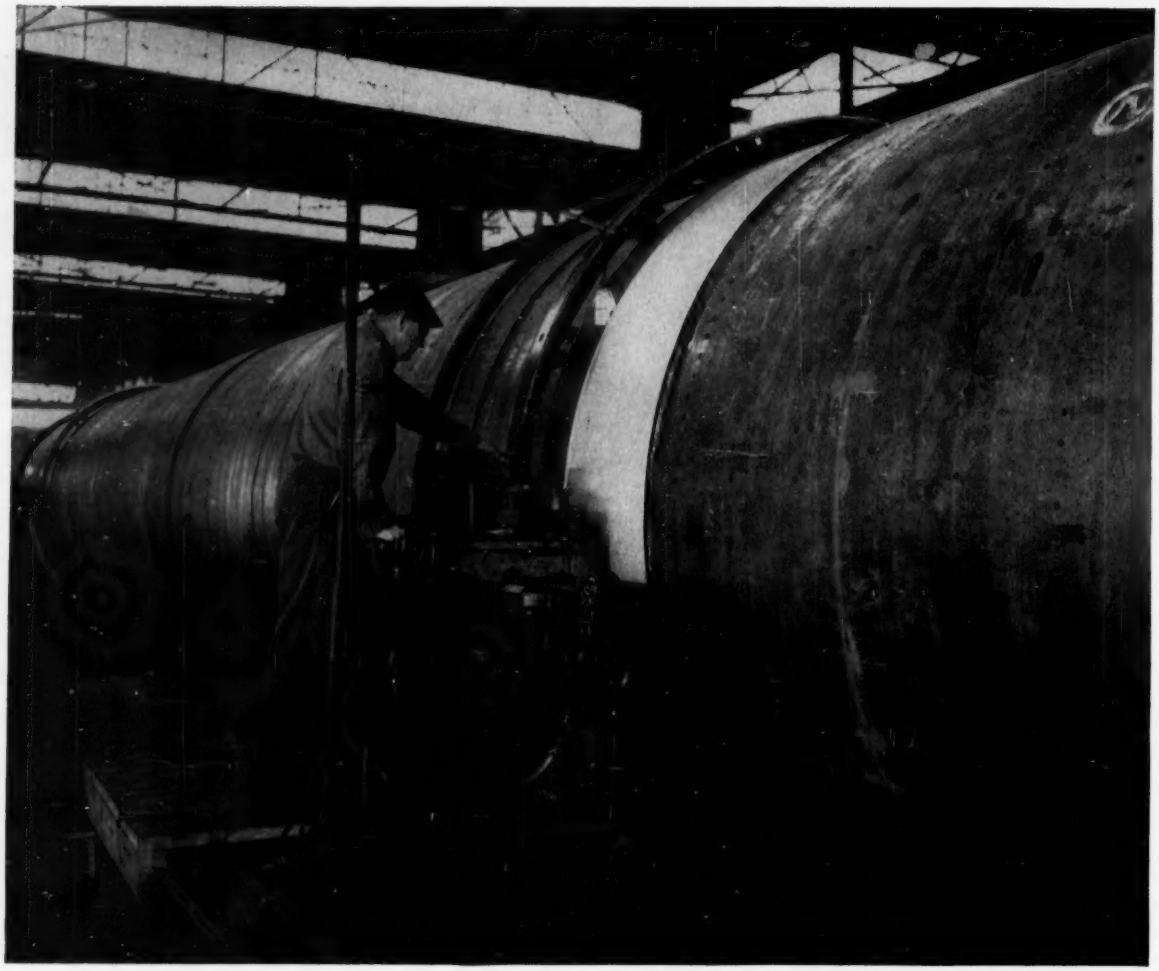
Let Timken Company metallurgical experts help solve your stainless pressure tubing problems. You can get Timken stainless steel pressure tubing in a wide variety of sizes and grades—some not available anywhere else. Get the most for your money. Specify Timken stainless pressure tubing. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable: "TIMROSCO". *Makers of Tapered Roller Bearings, Fine Alloy Steels and Removable Rock Bits.*

WHEN YOU BUY TIMKEN STEEL YOU GET . . .

1. Quality that's uniform from heat to heat, bar to bar, order to order
2. Service from the experts in specialty steels
3. Over 40 years experience in solving tough steel problems

TIMKEN® *Fine Alloy* STEEL

TIMKEN ALLOY STEEL AND SEAMLESS TUBING IS AVAILABLE FROM STEEL SERVICE CENTERS IN 44 CITIES IN THE UNITED STATES



Louisville Dryer—10 feet in diameter, 10 stories long!

Turn a ten story building on its side, and there'd be room to spare on either end of this huge pit lathe at Sharon, Pennsylvania where this 10′ x 110′ Louisville Dryer was fabricated.

This lathe is used for machining the reinforcing bands onto which are mounted the forged steel tires. This careful workmanship assures concentricity of the completed dryer shell—a primary factor in efficient seal operation.

Every Louisville Dryer is especially designed, manufactured, assembled and installed for its specific task.

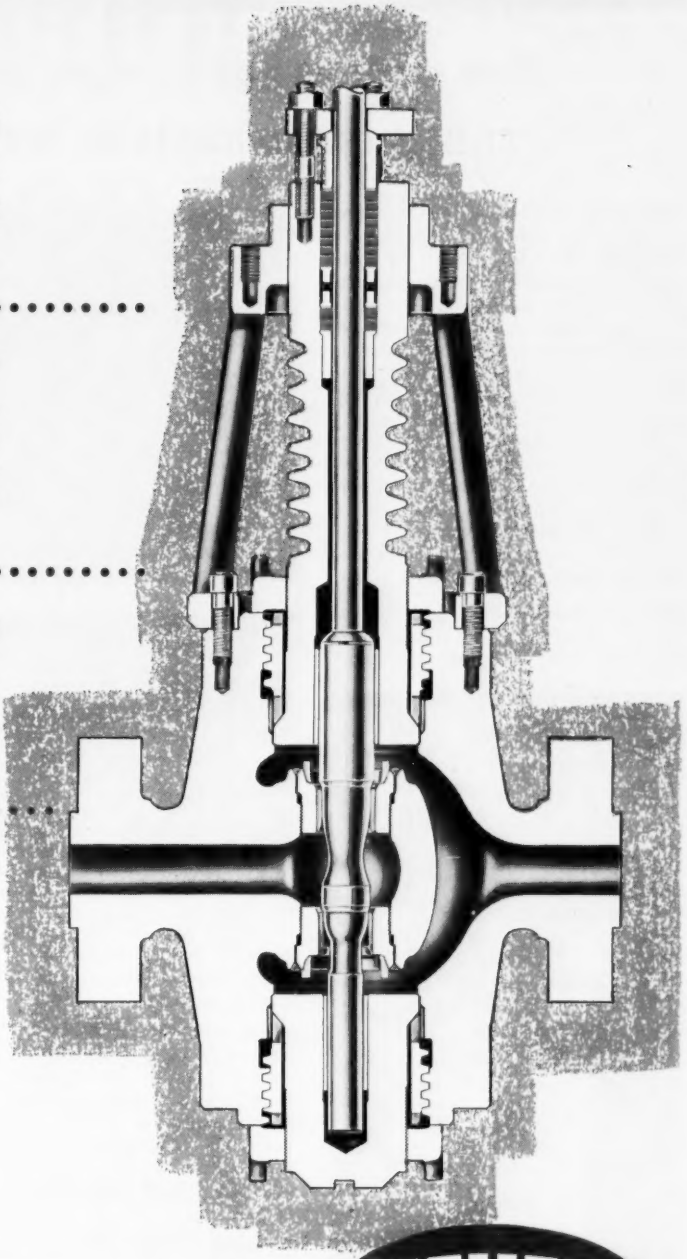
If you have a problem involving process equipment, call or write our equipment specialist in your area. Here, as in so many fields, you'll find IT PAYS TO PLAN WITH GENERAL AMERICAN.

Process Equipment Division
GENERAL AMERICAN TRANSPORTATION CORPORATION
135 South LaSalle Street, Chicago 90, Illinois
Offices in Principal Cities
In Canada: Canadian Locomotive Co., Ltd., Kingston, Ontario

Louisville Dryers

FISHER "HH" 2500 lb. A.S.A. BODIES

for HIGH PRESSURE AND TEMPERATURE SERVICE



CALL YOUR *FISHER/MAN*

Guides and bushings are Stellite faced to prevent seizing or galling. Guide posts are made extra large. This extra protection means longer life.

CALL YOUR *FISHER/MAN*

Screwed-in seat rings are Stellite faced to eliminate erosion and wire drawing. Fisher seal welds them in place to keep rings from working loose and to prevent leakage past the threads.

CALL YOUR *FISHER/MAN*

Available in single or double ported body designs—one and two inch sizes in the single ported and two, three and four inch sizes in the double ported design.

CALL YOUR *FISHER/MAN*

Use of a pressure sealed bonnet eliminates need for heavy, cumbersome flange heads. Head construction with or without cooling fins is available.

CALL YOUR *FISHER/MAN*
or write FISHER GOVERNOR COMPANY for complete information and literature.

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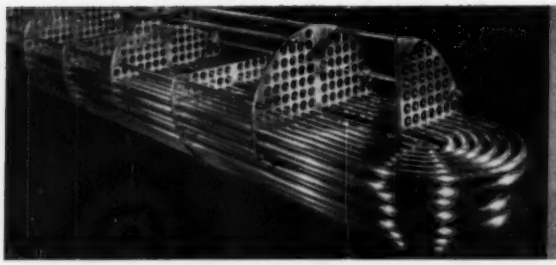


CONDENSER AND HEAT EXCHANGER CLINIC

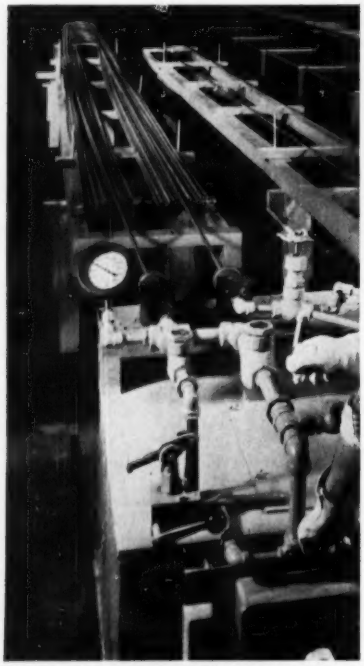
Edited by David S. Hibbard, Metallurgical Engineer
The American Brass Company, Buffalo 5, New York

New controls and services meet increasingly critical requirements in heat-transfer units

As steam cycles in turbines become more complex—and operating temperatures and pressures rise—the job of the heat-transfer equipment becomes increasingly critical. Nuclear energy plants place tremendous emphasis on continuity of service for even conventional components like condensers. And in many processing plants the cost of shutdowns may range from exorbitant to disastrous.

Assurance that tubes will meet service requirements becomes increasingly important. And The American Brass Company has augmented its normal quality controls with tests and services to help makers of heat transfer equipment prevent possible trouble before it starts.

Electronic inspection. All tubes are inspected visually one at a time, both internally and externally. However, where greater assurance is required, the tubes—in straight lengths up to 100′—can be inspected electronically by eddy-current equipment.

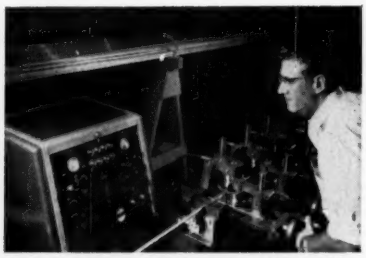


All U-bend tubes are tested hydrostatically at ASME Code pressures—or higher, if necessary.

Hydrostatic testing. As most U-bend tubes are used in applications involving high temperatures and pressures, all of these tubes are tested hydrostatically—after bending—at ASME Code pressures. They can, however, be tested at higher pressures, up to 6000 psi, if the tube size is such that it will withstand the pressure.

Relieving stresses. All U-bend tubes, other than copper, are annealed at the bend area after bending, to eliminate the hazard of stress-corrosion cracking which might occur in service due to stresses that may exist as a result of the bending.

All tubes are inspected visually one at a time, both externally and internally.

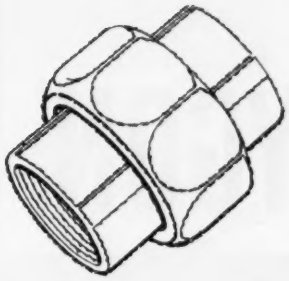


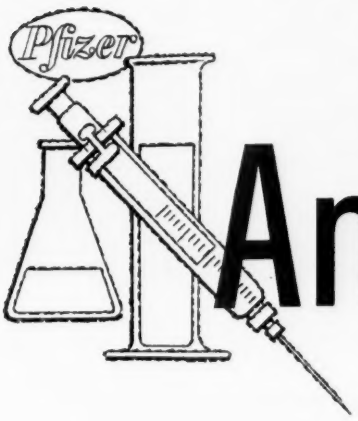
When required, tubes are inspected by eddy-current equipment, located at the tube straightener.

Duplex tubes are widely used in chemical plants and petroleum refineries to meet diverse combinations of corrosive action and/or pressure and temperature. Recently designers have selected them for use in air-removal sections of electric-power-plant condensers where corrosion is very severe.

Broadest service. In helping manufacturers and users of heat-transfer equipment meet day-to-day problems, The American Brass Company has a broad background in the latest developments in heat-transfer equipment's expanding role. And with new mill equipment now in place, it offers the broadest service available in tubes for heat-transfer equipment. For technical assistance in special problems, write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 5958

What do Rockwood Unions have to do with Antibiotics?





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- be easy to handle with no galling in make-up
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DEVELOPMENTS . . .

MAY 4, 1959

Chementator

C. H. CHILTON

Partial processing of solids while in transit in a pipeline is envisioned by engineers of Ford, Bacon & Davis. For example, a slurry of wood chips could be piped from a remote point and be partially pulped enroute to the pulp mill.

Compression-molded expanded polystyrene can now be cured by dielectric heat. New technique, developed by Koppers, speeds up curing cycle, lowers cost of compression molds.

Oil from Alberta's tar sands at $1/bbl. is possible via underground nuclear explosions. This is opinion of Gerald W. Johnson, test director of University of California Radiation Laboratory.

Ethylene oxide treats sour gasoline

A brand-new process for sweetening gasoline with ethylene oxide was disclosed last month at the Boston meeting of the American Chemical Society, and interested refiners are already beating a path to the inventor's door.

Although process patent (U. S. 2,862,804) has just recently issued to C. O. Petty of La Gloria Oil & Gas Co., La Gloria has been treating gasoline this way on a 3,000-bbl./day scale at its Tyler, Tex., refinery for more than three years. La Gloria tells *CE* that it will license other refiners to use the process.

The Petty process involves reaction of the objectionable mercaptans in the gasoline with ethylene oxide. The hydrogen of the mercaptan goes to the oxygen of the ethylene oxide, making an alcohol with a sulfide linkage in the middle. (Reaction is analogous with that in which a glycol ether is formed by adding ethylene oxide to an alcohol.)

However, reaction is very slow at ordinary temperature in the absence of a catalyst. An alkaline catalyst helps a little, but addition of phenols to the alkaline solution speeds things up so that mercaptan removal is almost complete in 5 min. contact time.

Sweetening unit at Tyler consists of a simple vertical packed tower through which a phenolic caustic solution continuously circulates. The gasoline flows upward through the tower, countercurrent to the aqueous phase. Liquid ethylene oxide is metered into the gasoline just ahead of the scrubber.

Process costs are primarily tied to consumption of chemicals, says Petty, since operation and maintenance costs are relatively low. A barrel of light catalytic gasoline takes an average of 0.35¢ worth of NaOH and 0.60¢ worth of ethylene oxide; for a thermal gasoline, these figures are 1.30¢ and 2.25¢, respectively. Consumption of phenols is practically nil.

Another sweetening process vying for attention at the ACS meeting was reported by Sun Oil researchers. This one—not yet com-

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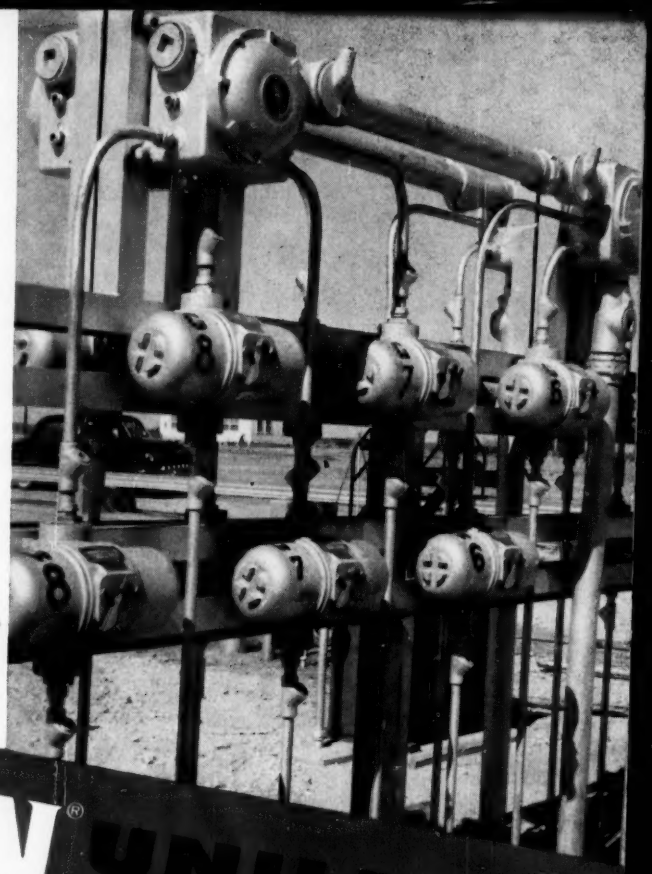
WHY SHOP AROUND?

As the illustrations on this page suggest, you can get practically anything needed for wiring or lighting in hazardous or non-hazardous areas from APPLETON. There is no need to "split" orders. Next time you buy, consult APPLETON . . . full information on request.



Control panel showing APPLETON *Unilets* in a wide range of styles and sizes in use at main line gas booster station

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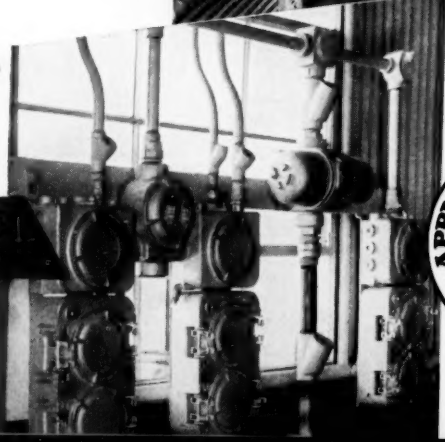
Hundreds of APPLETON *Unilets* can be seen in this typical generator plant cable room



Display panel board showing close-up view of several types of explosion-proof, weather-tight *Unilets* frequently found in oil refineries, chemical plants, steel mills and many other industrial areas

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mercial—involves air oxidation of mercaptans to disulfides while the gasoline is percolating through a bed of high-iron bauxite (U.S. 2,850,433). Sun figures it can be used effectively on certain types of streams, such as straight-run or thermal gasolines, at a cost of about 0.6¢/bbl., vs. about 5¢/bbl. for caustic treating of these stocks.

Surfactant speeds up sulfite oxidation

Although detergent-caused foaming of domestic sewage can be a major headache to disposal plant operators, deliberate addition of surface-active agents to a chemical waste stream is planned as an aid to pollution abatement.

Sherwin-Williams is now air-oxidizing sodium sulfite waste to sodium sulfate at its Chicago plant (*Chementator*, July 28, 1958, p. 51). This waste stream, which comes from beta-naphthol manufacture, contains the sodium salt of beta-naphthalene sulfonic acid, which acts as a wetting agent and facilitates dispersion of air in the liquid.

Another sulfite waste stream, due to be processed by the same technique, comes from a new para-cresol facility and does not normally contain any such wetting agent. Alone, it shows lower response to air oxidation than does the beta-naphthol waste.

But, as reported to ACS in Boston last month, addition of a surfactant such as Surf gives appreciable improvement. Questioned about the possibility of excessive foaming, S-W pointed out that strict control would have to be exercised in order to stay out of trouble.

Round one: Kellogg over Monsanto

Engineering and construction firms are breathing a bit easier this month following a recent New York court decision upholding the arbitration clause in a contract covering design and construction of a $6.5-million methanol plant by M. W. Kellogg for Monsanto and Heyden Newport.

Monsanto and Heyden are attempting to avoid arbitration of their differences with Kellogg on the grounds that Kellogg misrepresented its technical know-how (*Chementator*, Feb. 9, p. 55). This constitutes fraud, alleges Monsanto-Heyden, thus releasing them from their contractual obligations, including the arbitration clause. Monsanto and Heyden are seeking adjudication of their claims against Kellogg—totaling some $9.5 million—via a damage suit filed in Wilmington, Del.

Kellogg asked the New York State Supreme Court to compel Monsanto to submit to arbitration. Justice Aurelio agreed that the arbitration clause was sufficiently broad to embrace an issue arising on a claim of fraudulent inducement. Monsanto's other two claims against Kellogg—negligence and failure to perform—were obviously arbitrable, continued the judge.

The decision granted Kellogg's request for an injunction compelling Monsanto and Heyden to submit to arbitration in New York as well as staying the proceedings in the Delaware court. The judge did not pass on the merit or lack of merit of Monsanto's claim of fraudulent inducement, leaving this matter in the hands of the arbitration board.

Monsanto-Heyden will appeal this decision, says a Monsanto spokesman. The companies insist that "on the basis of the facts they are entitled to recover many millions in reimbursements for their losses." No matter where the case is settled—in arbitration or in law court—Monsanto and Heyden "expect to be awarded very substantial damages."

Is P.E. license just a union card?

If you are among that large majority of engineers who hold that (1) registration is a hallmark of professionalism and (2) unionization is the very antithesis of professionalism, take a look at this seeming paradox:

Seattle Professional Engineering Employees Assn., one of the nation's most active engineering unions, has proposed an amendment to the Washington State Engineers Registration Law which would, in effect, require universal licensing. SPEEA pushed for adoption of this amendment by the 1959 legislature but legislative time ran out.

Under the SPEEA proposal, all engineers responsible for designs, decisions, checking, etc., must be registered, whether or not they are employees of corporations and regardless of whether these corporations turn out products or plans. Present Washington law, like most other state laws, exempts from compulsory registration any engineer employed by a corporation which does not sell engineering services (as contrasted to products) to the public.

(Continued on page 42)

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SPEEA, the NLRB-certified bargaining agent for 8,000 Boeing engineers, believes that "licensing is an important factor in achieving increased stature for our profession" by preventing persons from calling themselves engineers "without actually being qualified."

The union is thus attempting to shift from the employer to the state the responsibility for deciding whether or not a privately employed engineer is qualified to do the work required of him by his employer. An instrument of law originally set up solely for protection of the public would, in effect, be perverted into a device for establishing a legalized "union shop." Corporations employing engineers will no doubt oppose this measure when it comes up for reconsideration in 1961.

The 1959 legislature did approve changes in Washington state law which give legal status to practice of engineering by corporations. Only a dozen or so states now continue to exclude corporate practice, although in none of them are such exclusions enforced.

But the new law is under attack even before it goes into effect. A group calling itself the Professional Engineers' Legislative Committee is trying to get enough voters' signatures before June 10 to force the issue into public referendum. The group is said to be getting support from doctors and lawyers who are opposed to corporate practice in professional fields.

Easy way to make polyurethane paints

A new step in formulation of postcatalyzed polyurethane paints opens up wider markets by simplifying the addition of pigments.

In postcatalyzed urethane systems, a prepolymer containing free isocyanate groups is cross-linked at time of application with relatively small amounts of catalysts and/or moisture. Until now, these systems have had limited use in coatings because the prepolymers could not be easily pigmented. The free isocyanates would react with the pigments' adsorbed moisture, impurities and surface treatment chemicals, causing gelling, gassing and poor film integrity.

Paint manufacturers can now lick these difficulties by mixing pigments in advance with a little isocyanate in a closed dispersion system such as a ball mill. The "neutralized" pigment is then dispersed in the prepolymer to make the desired coating vehicle.

Spencer Kellogg & Sons, Buffalo, developed this technique and introduced it at the ACS meeting in Boston last month. The company supplies prepolymers and other polyurethane vehicles to paint formulators, who'll do their own pigment mixing.

Offering outstanding exterior durability, chemical resistance, flexibility and toughness, and commercially available only within the past year, polyurethane coating vehicles are supplied in two other forms beside prepolymers: A one-can stable copolymer containing no free isocyanate groups; an isocyanate-polyol adduct containing free isocyanate groups and designed to be further reacted at time of application with large amounts of a hydroxyl component. Ability to pigment prepolymers now puts this third form in a position to capture a bigger slice of the urethane coating market.

Molecular sieves: Who's on first?

With new commercial uses of molecular sieves—such as Universal Oil Products' recently announced Molex process—set for launching, Linde has staked a broad claim on this field with its just-issued composition-of-matter patents (U. S. 2,882,243-4).

Moving quickly to exploit its legal position, Linde plans a sixfold increase in molecular sieve capacity at its Tonawanda, N. Y., plant.

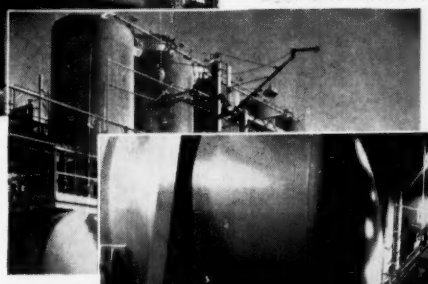
Next move is apparently up to Davison Chemical. Davison told *CE* several months ago that it was piloting manufacture of molecular sieves and expected to offer commercial products at around 75¢/lb., about one-half the price charged by Linde, only major supplier of molecular sieves at present. Davison has been waiting to get a look at Linde's patent claims before announcing its own plans for going into the molecular sieve business.

Another potential participant in this field is Texaco. In developing its new selective finishing process (*Chem. Eng.*, Oct. 20, 1958, p. 76), Texaco tailor-made molecular sieves which would adsorb low-octane normal paraffins but reject other components of naphtha or reformate. The same general idea is used by UOP in the Molex process.

Linde's patent identifies a molecular sieve as a synthetic crystalline sodium aluminum silicate, or a derivative thereof, with a basic three-dimensional framework of SiO_4 and AlO_4 tetrahedra. The sodium form is made simply by reacting a source of silica (silica gel, silicic

1 NORTH CLAYMONT, DEL.

BATON ROUGE, LA.



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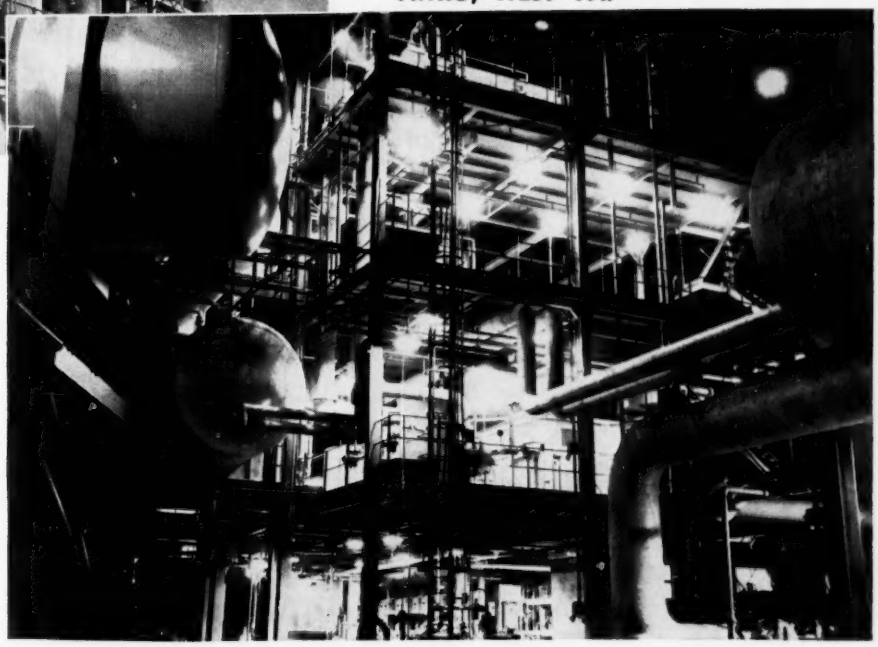

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acid or sodium silicate) with a source of alumina (activated alumina, alumina trihydrate, sodium aluminate, etc.). Sodium hydroxide may supply the sodium ion and assist in controlling pH. The synthetic zeolite crystallizes upon holding the reaction mixture at about 100 C. for a period on the order of 1-6 hr.

Other forms with different pore sizes can be made by exchanging the sodium ion for another cation, such as lithium, magnesium, potassium or calcium. This is readily done by passing a water solution containing the desired cation through a bed of the sodium zeolite. The potassium derivative has smaller pores than the sodium form, the calcium and magnesium forms have larger pores. Linde's patent emphasizes, however, that the basic crystal lattice remains essentially unchanged.

Russians seek rights to their ideas

Reports from the Eighth Mendeleyev Chemical Congress held in Moscow in March —first in nearly 25 years—indicate that Russia's chemical industry is growing up. It's getting more concerned with such practical matters as protection of inventions and faster commercialization of research findings.

Although some 1,400 papers were presented in 17 sections to more than 2,000 delegates from 19 countries, a major article appearing in *Pravda* midway during the congress stirred more comment than most of the scientific papers.

Written by Nikolai Emanuel, noted academician, the article pointed out that "more and more discoveries in chemistry are being made in Soviet laboratories without having precedent in practice abroad." Emanuel called on the government to protect the rights of both scientists and government to these inventions. One objective would be to make possible the sale of licenses to firms in non-Soviet countries.

Emanuel also disclosed a plan under consideration to reorganize chemical research on a team system to minimize the gap between discovery and practice. A "specialist-organizer with both theoretical and practical background" would manage each team until completion of the project. (Apparently Russia has discovered the chemical engineer.)

Other news items from the congress:

• Plastics Institute has developed plastics containing radioactive isotopes of cobalt which could play an important role in treating different diseases when prolonged but weak irradiation of patient is necessary.

• Plastics Institute has an installation for continuous production of graft polymers. It uses a mechanical-chemical method which makes it possible to break molecules of parent polymers and combine them into new substances.

• Within seven years, Russia will be able to discontinue completely the import of natural rubber due to scheduled increase of synthetic rubber output. This was revealed by Victor Fyodorov, chairman of the State Committee for Chemistry.

Nuclear heat into electricity

First direct conversion of nuclear reactor heat to electricity took place last month at AEC's Los Alamos Scientific Laboratory. A novel "plasma thermocouple," developed by LASL, achieved a record 17% efficiency, delivered about 130 watts of d.c. power to light a lamp for 12 hr.

This was not the first use of a thermoelectric device to transform nuclear energy into electricity. Earlier this year SNAP III converted heat of decay of polonium-210 to electrical energy at a 5.5% efficiency (*Chem. Eng.*, Mar. 23, p. 102). However, Los Alamos is first to convert nuclear reactor heat directly to electricity and thus sidestep reactor coolant loops, steam cycles and turbines.

The plasma thermocouple differs from usual bimetallic configurations. A uranium rod, ¾-in. long and ¼-in. dia., is suspended in a tube filled with cesium vapor. When this assembly is lowered into the critical core of the Omega West reactor, the uranium rod fissions and releases heat.

Cesium gas is thus thermally activated and stripped of electrons, which flow toward the uranium bar. Potential difference between cesium and uranium (3.8 v. at open circuit) drives a current of 30-40 amp. across a short circuit between the tube shell and the uranium bar.

AEC officials foresee electrically powered rockets and mobile, compact, power-generating facilities. But for the immediate future plasma thermocouples may be used to provide auxiliary power to operate electrical equipment in nuclear-powered rockets and submarines.

For more on DEVELOPMENTS.....46

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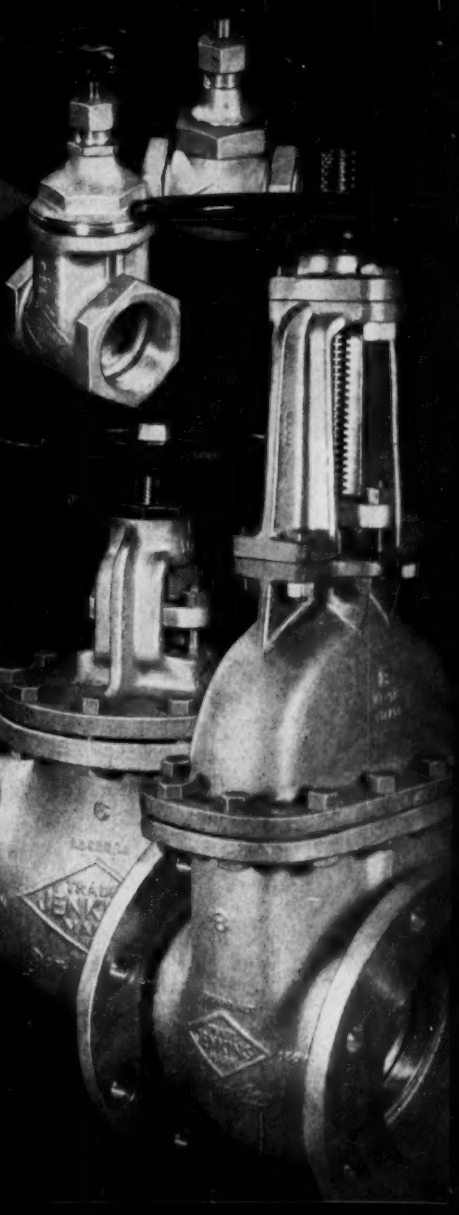

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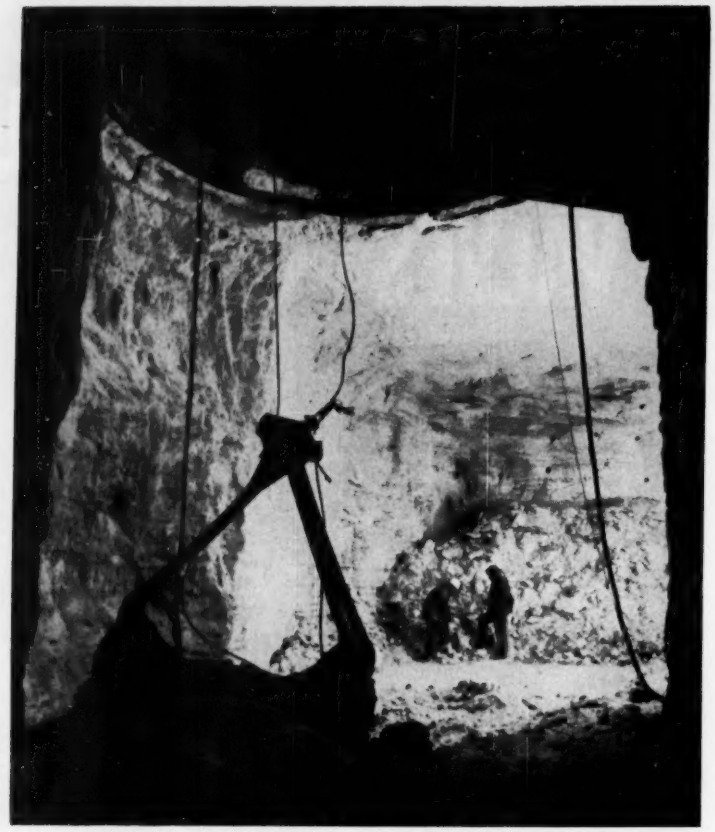


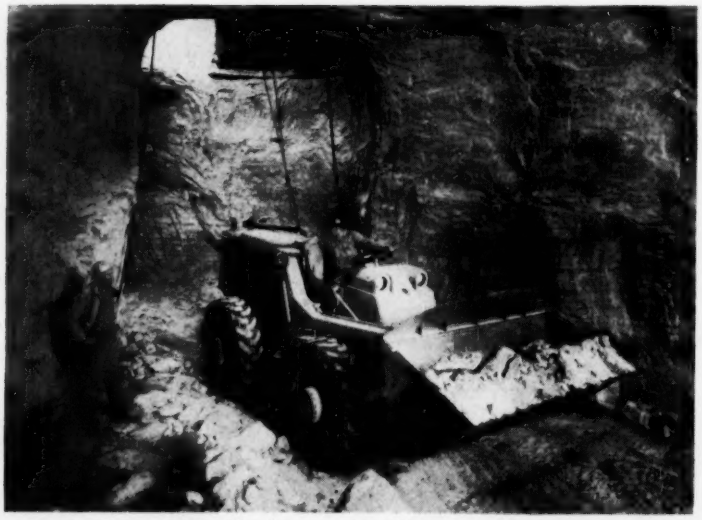
COMPLETION of 2,000-ft. shaft provides entry to big salt deposit.

Salt Users

First new U. S. salt mine in quarter century offers eastern industries a prime source of various rock-salt grades.

News of a major development in supply of a basic raw material claims top recognition this month. Near Painesville, Ohio, Morton Salt Co. culminated a three-year, $6-million effort with production of the first salt from its new Fairport mine, 2,025 ft. below the surface.

From a new mill at the mine outlet, Morton will ship salt via



MINED salt carried by diesel-powered equipment will be hoisted up shaft.

Gain New Supply From Vast Vein

rail, truck and ship to most of the states from the Mississippi east to the Atlantic.

Following completion of twin shafts down to the deposit during the winter, Morton is working toward a full production rate of 300 tons/hr. by the fall of 1959.

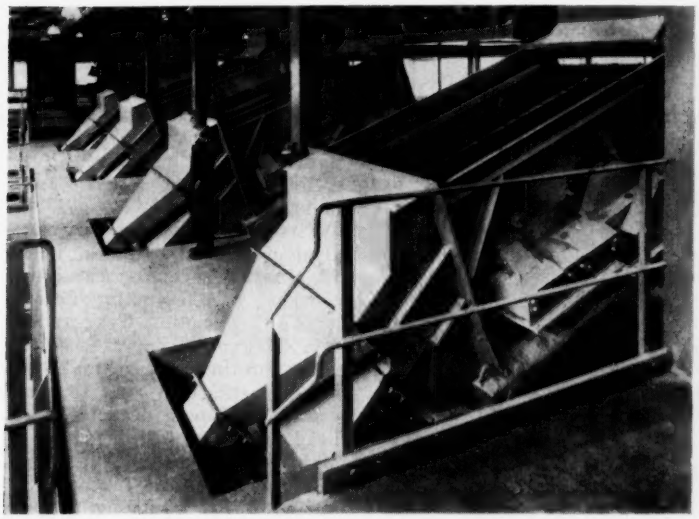
To meet future demand, the facilities will handle expansion of output to an ultimate level of 500 tons/hr. At a production rate of 1 million tons per year, reserves in Morton's 6,000-acre lease are sufficient for 200 years.

▶ **Updates Old Practice**—As the first new U. S. salt mine in 25 years, Fairport provided Morton with the opportunity of wrapping up years of accumulated experience in one complete new package.

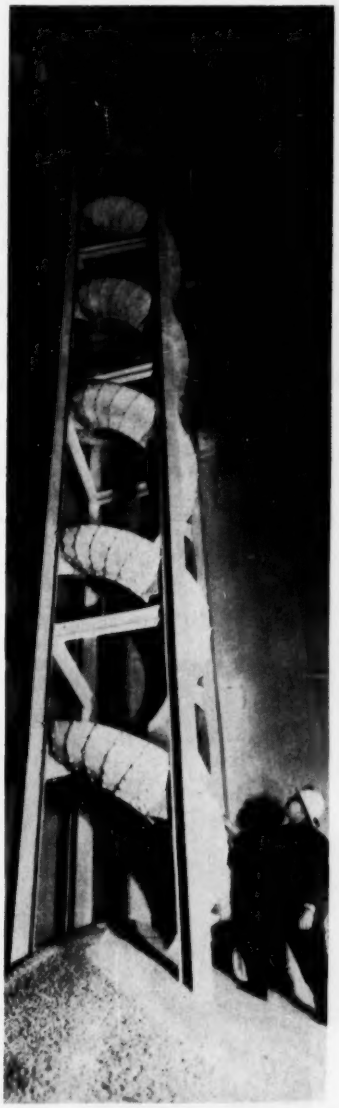
Entrance to the mine is through two concrete-lined, vertical, circular shafts which descend through layers of shale, limestone and sandstone to the 2,000-ft. level. Salt from the mine will rise via 10-ton skips through the 16-ft. production shaft while men, equipment and supplies move through smaller 12-ft. dia. shaft located 150 ft. away.

▶ **Mechanical Mining**—At the working face of the mine, Morton will use the latest mining equipment including undercutters, loading machines and front-end loaders. Giant, diesel-powered, earthmovers will haul salt from the working faces to underground screening and stage-crushing operations.

Story continues, turn page.



CRUSHED salt passes over these screens for separation into final grades.



FINISHED salt slides down spiral chute into 1,200-ton storage silo.

Here, big grizzly screens will scalp off massive oversize chunks for primary crushing. Discharge from this crusher will join grizzly undersize for secondary crushing. By suitable screening of the crushed material, an impure calcium sulfate fraction will be rejected and left underground.

▶ **Avoid Breakage**—At the top of the shaft, skips dump into bins which maintain continuous flow of salt through the mill. From this point to final packing and/or loading of finished product, all equipment in the mill is designed to handle the salt crystals with minimum breakage. Thereby, Morton protects rock salt's important competitive advantage of relatively large particle size at reasonable cost.

Discharge from the feed bins rides to the top of five-story mill on a continuous conveyor belt. Passing under a magnetic pulley which removes tramp iron, salt leaves belt via chute feeding vibrating screens. This chute and others carrying salt down through various process stages are inclined to keep salt from falling free and breaking under impact of landing.

▶ **Various Grades**—Combination of vibrating and oscillating screens separate salt into standard commercial grades, i. e., No. 2 (¾ in. x 4 mesh), No. 1 (⅜ in. x 8 mesh), C. C. (⅛ in. x 12 mesh) and F. C. (through 8 mesh). These grades can be blended to satisfy customer preference, if so desired.

Oversize material passes through a hammermill circuit. Particles of calcium sulfate impurity freed by the crushing are sufficiently different from the salt crystals so that they can be separated by screening and rejected.

▶ **New Fines Recovery**—Older rock-salt operations accept loss of sizable quantities of output as nonmarketable fines. Even with added handling care, Fairport will still have an appreciable percentage of its throughput passing into this finer fraction.

But, in Fairport's case, this material will be converted back to larger-sized particles, thereby assuring essentially complete utilization of mined salt. Fines passing through final screening will move to a unique agglomerating or compacting process (*Chem. Eng.*, Nov., 1957, pp. 154-156).

Preconditioned with saturated salt solution, which acts as a binder and plasticizer, fines pass through set of compacting rolls. Pressure on the order of hundreds of tons forms continuous sheet of salt. Reduction of sheet first to flakes, then to granules, completes conversion of fines to marketable particles.

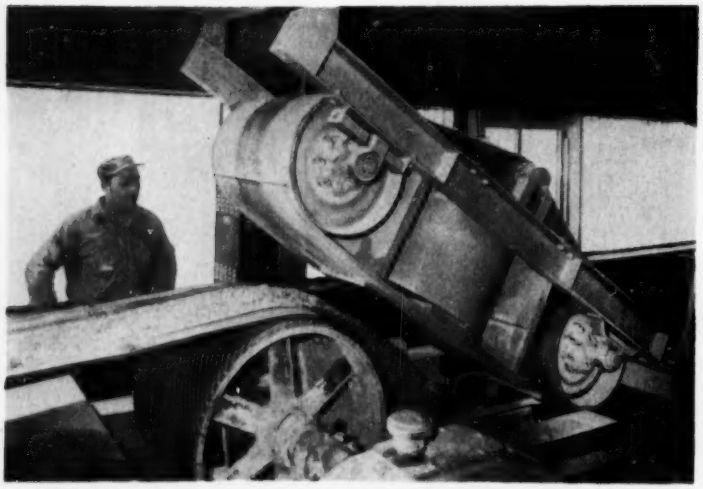
▶ **On to Storage**—Each finished grade of salt passes from screens via belts, elevators and belts to one of 12 storage silos, 35 ft. in dia. by 85 ft. tall. A unique spiral chute (see photo) in each silo delivers salt to top of pile without degradation of particles.

Each silo holds 1,200 tons of salt. Bottoms slope toward gates feeding onto final loading belts.

Design of Fairport's conveyor system for handling various products to packing and loading stages, either directly or via storage, is a story by itself. Suffice it to say that product can be packaged in sacks up to 100 lb. size and loaded into boxcars or trucks. Or, it can be bulk loaded into trucks or railroad cars at 400 tons/hr. rate.

By virtue of its location near the mouth of the Grand River which empties into Lake Erie, Fairport can load directly into 6,000-9,500-ton steamships at rates up to 600 tons/hr. Again, design of the conveyor and loader system minimizes degradation.

▶ **The Market**—With a potential output of 1 million tons/yr., Fairport will be a major producer in rock-salt industry whose total 1957 shipments were 6.5 million tons, or 60% of total dry salt moved. And with such a strong position, Fairport will be well set to service industry.



ENTERING mill, crushed salt gives up tramp metal to magnetic separator.

New Catalysts Shine In Commercial Tests

Claims for the long life of Socony Mobil's new Durabead cracking catalyst (*Chem. Eng.*, Feb. 23, 1959, p. 60) are being proved in commercial operation, according to a paper given at the Western Petroleum Refiners' Association meeting in San Antonio, Tex.

First unit to use the new catalyst exclusively was a Type 75 airlift Thermofor catalytic cracker at Magnolia Petroleum's Beaumount, Tex., refinery. Magnolia reports a 70% reduction in catalyst make-up requirements compared to conventional chrome beads. Durabead was also introduced as a make-up catalyst in 33 moving-bed cracking units in the U.S. during 1958, achieving reductions in make-up addition rates

Passes acid test—by more than 3 times

Unloading carloads of concentrated sulphuric acid proved a hose-killing job at this Gulf state fertilizer plant. Time after time, the acid charred the insides of a hose, making it brittle and easy to break. Even the best one could handle only 2,800 tons before it gave up the ghost.

Then the G.T.M.—Goodyear Technical Man—suggested HYSUNITE Hose. It's specially developed to carry highly oxidizing acids—even in high concentrations and at high temperatures hose could never before handle. How did HYSUNITE do there? *At last report, it had unloaded 9,900 tons. And it looks good for many more.*

Here's one more proof, then, that hose problems just don't come too tough for the G.T.M. Put him to the acid tests—no matter what your hose need—by contacting your Goodyear Distributor—or writing:

Goodyear, Industrial Products Division,
Akron 16, Ohio

HYSUNITE HOSE by

GOODYEAR

THE GREATEST NAME IN RUBBER

Hysunite—T.M. The Goodyear Tire & Rubber Company, Akron, Ohio

IT'S SMART TO DO BUSINESS *with your Goodyear Distributor. He can give you fast, dependable service on Hose, V-Belts, Flat Belts and many other industrial rubber and nonrubber supplies. Look for him in the Yellow Pages under "Rubber Goods" or "Rubber Products."*

that drop consumption 30-50%.

In addition to longer catalyst life, tests also show Durabead to have a faster carbon burning rate—increasing the capacity of units previously limited by catalyst regenerator capacity. Too, Socony claims a more valuable product distribution: 25% more gasoline for each pound of carbon formed on the catalyst.

Another new catalyst, Heavy Durabead, is now being commercially evaluated. Heavy Durabead is claimed to have all the advantages of Durabead plus a higher density—giving a 50% increase in reactor and regenerator capacity over those attained with chrome beads. Or in the design of new cracking units, use of the heavier catalyst could give a 20% saving in cost of the catalytic section. Both catalysts are now commercially available.

Helium Can Be Shipped As Liquid, Study Shows

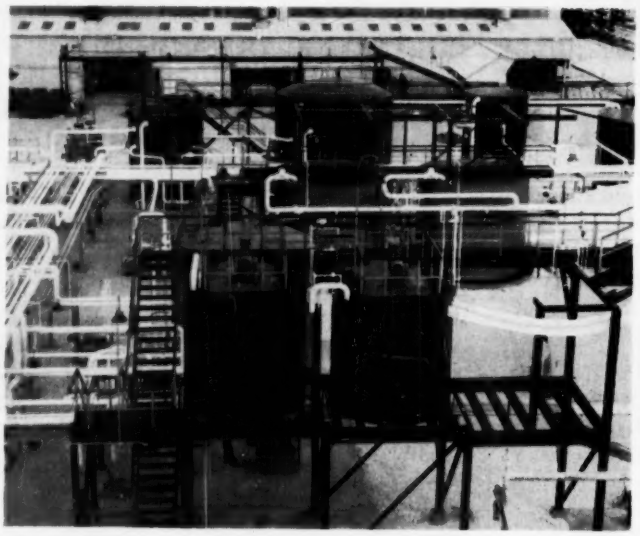
Helium in large quantities can be shipped more economically over long distances as a liquid rather than as a gas under high pressure as in current practice. This is the conclusion reached in a feasibility study conducted for the Navy by the National Bureau of Standards' Boulder, Colo., laboratories.

Helium has been in the national headlines recently because of the danger of demand far outstripping available supply. This demand—for civilian as well as defense uses—has prompted the government to start construction of a new helium extraction plant (*Chem. Eng.*, Dec. 31, 1958, p. 137) and spurred the Navy to sponsor this study for the most economical way to ship helium.

Liquefaction procedure suggested by the Bureau consists essentially of the Claude cycle: One expansion engine operating at a temperature below that of a liquid nitrogen precooling bath (−320 F.). Bureau was able to take advantage of the 170-atm. pressure of helium coming from the production plant by employing another expansion engine in the feed stream to pre-chill the helium for conservation of the nitrogen coolant (operating pressure in the liquefier is only 15 atm.).

Pipelines to transfer liquid helium to transport containers are insulated and shielded with liquid nitrogen or air. Transport vessels (railroad tank cars or truck trailers) would be of conventional design: liquid nitrogen shielded, three-shell construction with evacuated powder insulation. By using the new cryogenic insulations, such as the one recently announced by Linde, liquid nitrogen shield can be eliminated, Bureau says.

Report says further that if the inner stainless steel vessel is designed to withstand a 10-atm. pressure rise over a 10 to 15-day period, liquid helium can be shipped anywhere in the U.S. with no losses.



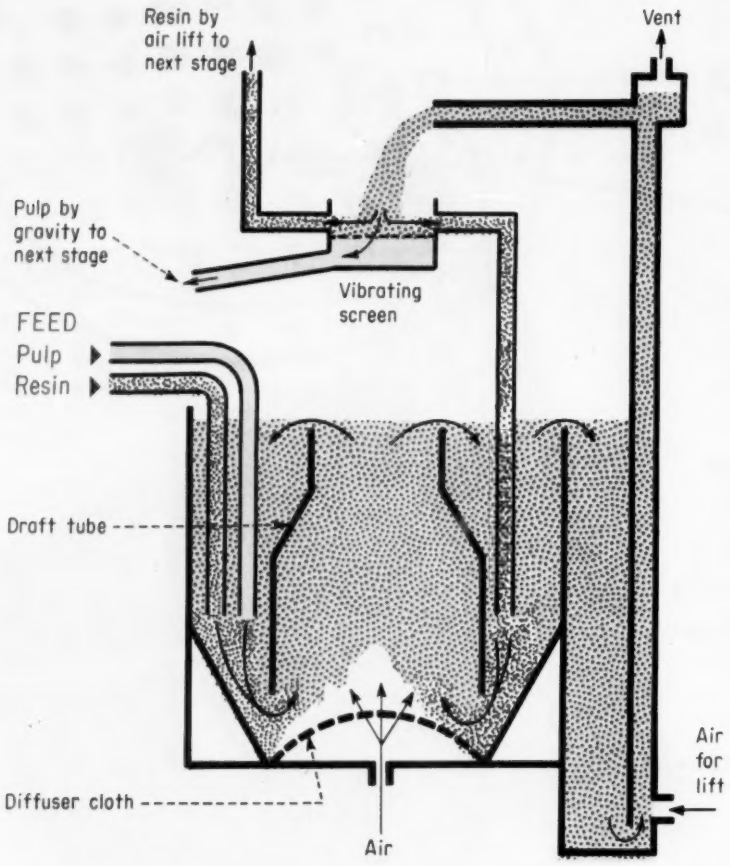
Now: More Chlorine, Caustic Soda From the South

When it reaches full capacity around the year's end, Wyandotte Chemicals' chlorine caustic plant at Geismar, La., will have a daily capacity of 300 tons of chlorine and 330 tons of caustic soda. The $25-million plant uses as raw material brine from two 8,500-ft.-deep wells. Picture shows brine-purification unit in foreground. In the maintenance building, background, the 30,000-amp. diaphragm cells are kept at maximum efficiency.

Molybdenum Powder Now Made in One-Step Route

Metals and Residues, Inc., Springfield, N. J., has come up with a one-step route from molybdenum oxide to the metal which, it says, has several advantages over present two-stage process.

At present, molybdenum oxide is reduced first to the brown oxide at 400-500 C., then to the metal at 1,000-1,050 C. In its one-step reduction at high temperature (not revealed), Metals and Residues claims it gets greater economy of energy, higher-purity moly powder and higher recoveries.



New Contactor Unravels Difficult Ore

High in clay, low in valuable mineral, a difficult Colorado ore yields uranium through unique upgrading and recovery in thickener-type exchangers.

Nature put uranium in the crust of the Colorado plateau; getting it back is man's problem. And the task is especially hard when uranium content of the ore is low and slimes content is high.

Exactly this combination of conditions spurred engineers of Trace Elements Corp. (subsidiary of Union Carbide Corp.) to rack up two new "firsts" in uranium milling technology.

At its 300-tons/day uranium mill on stream since late 1957 at Maybell, Colo., Trace Elements Corp.:

- Upgrades low-grade ore by rejecting a barren, plus-200-mesh fraction via wet classification ahead of the leaching step.
- Recovers uranium by novel ion exchange between leached-ore pulp containing 30% suspended solids and resin beads slurried in the pulp.*

* First description of plant's flowsheet was given at Annual Meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers, Inc., San Francisco, Feb. 16-19, 1959 by K. W. Lentz of Union Carbide and F. T. Temple of Trace Elements.

4 reasons why you'll sell more with Continental "F" style cans

1. Easy stacking

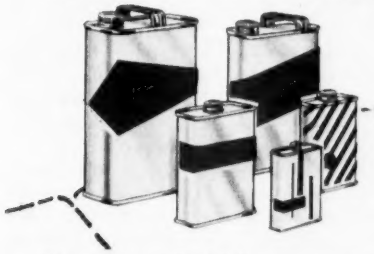
"F" style cans have a recessed bottom that fits right on top of can below. No chance of display toppling over. Display remains attractive and firm no matter how active the buying.

2. Excellent lithography

Continental's superb lithography adds sparkling appeal to your product. Broad face of can allows ample space for "family" name, product name and sales message.

3. Variety of sizes

Continental has exactly the size your customer wants. "F" style cans are readily available in sizes ranging from 8 ounces to one gallon.



4. Save shelf space

Oblong shape allows more units to be stocked per shelf foot. Facilitates powerful mass display that means extra sales.

CONTINENTAL CAN COMPANY

Eastern Division: 100 East 42nd Street, New York 17
Central Division: 135 South La Salle Street, Chicago 3
Pacific Division: Russ Building, San Francisco 4
Canadian Division: 5595 Pare Street, Montreal, Que.

Trace Elements upgrades its low-grade ore, having an initial U_3O_8 content below 0.2%, to save leaching acid. More than half the ore processed is low grade. If leached without a preliminary upgrading step, this low-grade ore would consume too much acid and require larger vessel capacity.

Unusual ion-exchange system at Maybell is first commercial application of a continuous, countercurrent, slurried resin system developed by Infilco-Techmanix, Tucson, Ariz. (*Chem. Eng.*, May 1957, p. 160). Use of fixed- or moving-bed ion exchange (*Chem. Eng.*, Sept. 22, 1958, pp. 80-82) was ruled out because slimes prevent solution clarity needed by such systems.

▶ **Better Than Baskets**—Slurried-resin ion exchange is a radical departure from conventional resin-in-pulp (RIP) method where resin suspended in baskets contacts the pulp in tea-bag fashion (*Chem. Eng.*, Dec. 1957, pp. 150-152; May 1957, pp. 228-231).

Reasons why slurried-resin system was chosen are grounded in some solid advantages:

- Slurried-resin process handles 30% solids pulp, whereas basket RIP is limited to approximately 10% solids.
- New system can use a fine-bead resin, which is cheaper than larger beads used in baskets.
- Inventory of resin per pound of U_3O_8 recovered is lower.
- Rate of resin replacement is lower than in some basket RIP plants.

Ability to process pulp with high solids content leads to use of more compact equipment with lower capital and operating costs; entire Maybell ion-exchange circuit covers an area only 40 x 50 ft. In the elution circuit, eluate concentration comes out twice as strong as comparable RIP eluate, thereby decreasing precipitation costs.

▶ **Start With Upgrading**—Maybell mill employs two sulfuric acid leaching circuits: One for high-grade ores containing over 0.2% U_3O_8 and the other for uranium-bearing slimes discharging from upgrading operation on low-grade ore.

Before leaching, low-grade ore is pulped with water and classified at 200 mesh by spiral classifier. Sand fraction is washed free of uranium-bearing slimes in a second classifier and rejected.

Overflow from first classifier containing uranium values and 95% minus-200-mesh particles thickens in a 100-ft. concrete thickener. Underflow is automatically weighed and sampled as it leaves thickener.

▶ **Follow With Leach** — Pulp then mixes with sulfuric acid and is leached in two stages of vertical digesters. Overflow from second stage flows to trash screen where it mixes with minus-325-mesh pulp from high-grade leaching circuit.

In the high-grade leaching circuit, leached pulp discharging from the digesters goes through classification, washing and thickening to produce the minus-325-mesh, uranium-bearing pulp flowing to the trash screen. A complex arrangement of spiral washing classifiers and cyclones removes all uranium values from the plus-325-mesh solids.

Mixed slimes passing through the trash screen are conditioned with anhydrous ammonia before feeding to the ion-exchange circuit.

▶ **Optimum Particle Size** — Experience shows that particle separation around 325 mesh is optimum for the Maybell ore. Particles finer than 325 mesh contain most of the uranium values. And they easily pass through the screens used for separating resin from pulp in ion-exchange circuit.

High-grade circuit achieves a nominal 325-mesh separation. But, as indicated above, upgrading circuit makes a coarser separation at 200 mesh. Plans are "rapidly nearing completion" for improving the classification in upgrading circuit to hit the 325-mesh goal.

▶ **Resin Meets Pulp** — In the loading section of the ion-exchange circuit, resin and leach pulp flow countercurrently through a series of six, stair-stepped ion-exchange tanks (see sketch).

Resin and pulp entering one of these tanks mix intimately in draft tube under agitation from air flowing up through cloth panel at bottom. Slurry of resin and pulp moves upward and overflows the top of draft tube.

Part of this flow recirculates back to bottom of draft tube. Remainder discharging from top of tank is air-lifted onto vibrating screen located over tank.

Resin is retained on screen. One-half of resin recycles back into same tank. Remaining half is air-lifted up the line to next tank.

Pulp passes through screen cloth and flows by gravity down the line to next tank. There, it picks up resin being air-lifted from tank still farther down the line.

Carbide declines to go into any further details of how it accomplishes this pulp-resin transfer between tanks.

Barren pulp from last screen it neutralized and discharged to waste. Loaded resin from first tank goes through spray washing and dewatering before dropping into elution circuit.

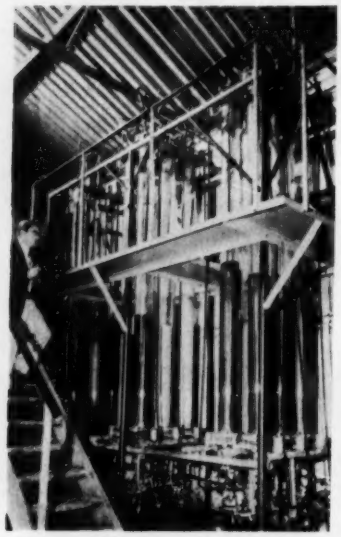
▶ **Strip Off Uranium**—In elution circuit, loaded resin contacts a 1.2-M ammonium nitrate solution at pH 1.0 in countercurrent flow through 10 tanks.

Operation is similar to that in loading tanks except for absence of screening. Since resin is the only solid present, it separates from eluate by settling into boot after overflowing draft tube.

To prevent enriched eluate from flowing out with resin in the air lift, it is displaced by a sidestream of leaner incoming eluate fed directly into boot. Thus, eluate entering next tank with resin is same composition as eluate in that tank.

▶ **Final Steps**—Pregnant eluate from last tank flows through two-stage precipitation at pH 4 and pH 7. Precipitate is filtered, repulped and pumped to top of multiple-hearth roaster.

Dewatered resin goes through two-stage sulfating with sulfuric acid before recycling back to loading section. Overflow from sulfating, containing recovered nitrate ions, is used for adjusting pH of barren eluate at first elution tank.



New Discoveries Key To High-Purity Rhenium

Behind the recent announcement that high-purity wrought rhenium is available for the first time (from Chase Brass & Copper) stand several new discoveries in the field of extractive metallurgy and metal forming. Kennecott Copper, Chase's parent firm, pioneered a new recovery process for supplying pure rhenium compounds while Chase came up with the necessary new metalworking techniques to make formed metal.

Rhenium, a silver-colored metal, has a high melting point (5,756 F.) surpassed only by tungsten and carbon.* Oxidation resistance is good up to 1,100 F. and electrical properties are said to be exceptional. Possible applications are opening up in molybdenum alloys, high-temperature thermocouples and missile components demanding high strength and high melting point.

▶ **Scarce Element**—Rhenium exists in trace amounts in molybdenite ores; most rhenium produced to date has been scavenged from flue dust leaving molybdenite roasters. But this material is far from pure.

Kennecott researchers tackled the recovery problem from scratch. Right off, they found that most of the rhenium was going up the stack not as dust but as a gas—sublimed rhenium oxide (Re_2O_7). Then they found that the oxide could be removed from the gas by a water spray and rhenium content built up to a workable range by recycling the scrubbing liquor.

Ion exchange wins the rhenium from solution at Kennecott's Washington, Pa., plant. Following "conditioning and filtering" to remove impurities, rhenium is adsorbed in a series of ion exchange columns. Rhenium is then eluted with a perchloric acid solution and treated with ammonia, precipitating high-purity ammonium perrhenate.

▶ **Reduce and Form**—At Chase's Waterbury, Conn., plant, ammonium perrhenate is hydrogen-reduced to metal powder. Powder is then compacted at 25,000-30,000 psi. and presintered for 2 hr. at 2,200 F. and 0.5-1-micron pressure.

Final sintering in hydrogen atmosphere at 2,800 F. produces a bar of 90-96% theoretical density. Fabrication of bars into shapes is done by cold-working, requiring frequent annealing.

Chase is scheduling production of only 100 lb. of rhenium this year since uses for the metal are still in the experimental stage. Total U. S. production is estimated at 1,000 lb./yr., although potential capacity is 20,000-30,000 lb. Typical prices for Chase's wrought metal is $680/lb. for powder, $780/lb. for bar and $2,125/lb. for strip.

* Carbon actually has no melting point; it vaporizes at about 6,650 F.

Sodium From Reactor May Preserve Food

Atomic Energy Commission recently approved a design modification on the Hallam, Neb., sodium graphite power reactor that might eventually lead to a food irradiation facility being built adjacent to the reactor station. The 75,000-ekw. reactor is being constructed by Atomics International for the Consumers Public Power District.

Modification, according to AI, consists essentially of a piping system running from the reactor's sodium cooling system to the outer wall of the reactor building. This would make it possible to draw off the highly radioactive sodium coolant from the core and use it as a radiation source for food irradiation.

Proposed irradiation unit would be equipped to process a wide variety of foods such as meat, potatoes, onions and beets. Operating capacity, estimated in the design study, would be 520 tons/day, at a radiation level sufficient to impart limited preservation. Capacity could be raised to 800 tons/day if food was in standard containers.

Studies conducted by AI show that irradiation can completely eliminate infestation in products such as grain and can increase the shelf-life of refrigerated meat five-fold. Reports further show that no toxic effects have resulted from human consumption of food sterilized by radiation.

NEWS BRIEFS

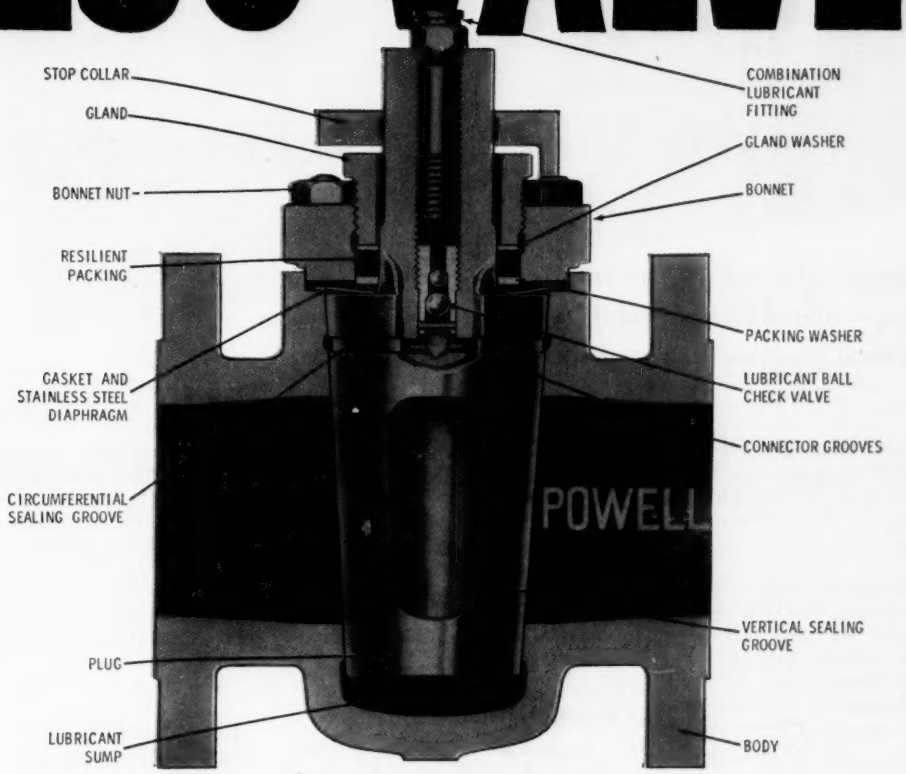
Caprolactam from benzene: Soviet Russia has developed a new process for making caprolactam from coke-oven benzene instead of phenol which is available only in limited amounts. Reaction takes place at moderate conditions in a reactor setup which reportedly eliminates impurities.

Polyphenyl ether: Monsanto Chemical Co. has received a contract from materials laboratory, Wright-Patterson Air Force Base, Dayton, Ohio, to supply research quantities of polyphenyl ether for testing as high-temperature lubricants, hydraulic fluids and greases.

Solid fuels: Standard of Indiana is developing special-purpose solid fuels and equipment for the Air Force Minuteman, first all-solid-fuel intercontinental ballistic missile. Standard will work to improve propellant formulations and incorporate developments into a gas generator.

POWELL

LUBRICATED PLUG VALVES



Sectional view Powell Screwed Gland Lubricated Plug Valve.

Like all Powell Valves, Powell Lubricated Plug Valves are superior in their field . . . and have many advantages over other conventional types of Valves.

- Simple design: only three basic parts—Body, Bonnet, Plug.
- Quick, complete shut-off—a quarter turn will close or open the valve.
- Tapered Plug assures positive seating.
- Machined surfaces of plug and body are not exposed in the open position. Any media adhering to the plug when in the closed position is removed when plug is rotated.
- Cavity-free straight passage assures streamlined flow in either direction. Scale and sediment cannot collect.

Powell Lubricated Plug Valves are available in sizes ½" through 16", depending on the type required—Semi-steel 175 and 200 pounds WOG;—Carbon Steel ASA 150 and 300 pounds.

Powell can also furnish Lubricated Plug Valves in other alloys on special order.

For all your valve needs, make it a policy to consult your local Powell Distributor—or write directly to us.

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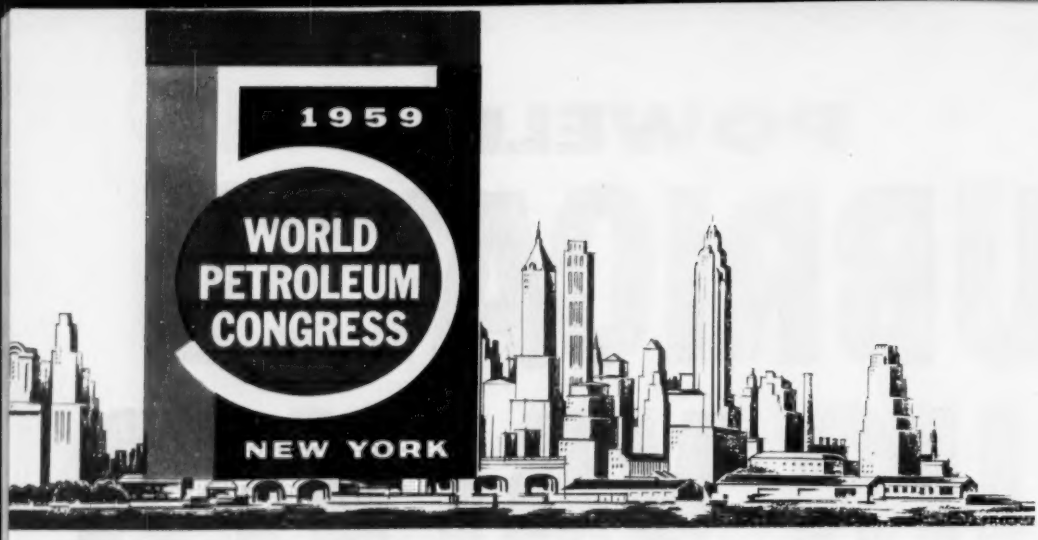
Dependable Valves Since 1846 • Cincinnati 22, Ohio



New York to Host World Oil Congress

- **Technical program features over 280 papers.**
- **Exposition will have exhibits of some 250 companies.**
- **Travel program boasts country-wide trips.**

Oil men from all over the world will converge on New York City May 30 through June 5 for the 5th World Petroleum Congress, to be held in the city's Coliseum.

This will be the first Congress to be hosted in the U. S. and oil men expect a capacity turnout. Since its founding in 1933, the Congress has grown in scope and importance as industry realized more and more the importance of such an international forum.

In addition to technical programs, the Congress features a special Ladies' Program and a banquet in the Ballroom of the Waldorf-Astoria Hotel.

Technical Scope

Technical papers will range over topics from geology to refining and transportation and distribution. Beginning on this page, *Chemical Engineering* lists selected papers especially interesting to you. Our list has been selected from the tentative list issued in Oct., 1958.

Morning technical sessions will be from 9:15 to noon; afternoon sessions, from 2:00 to 4:45. Following these sessions, at 5:30 on each of the first four days, will be a general lecture of broad appeal. Particularly interesting should be Organometallic Compounds in Petrochemistry by Karl Ziegler.

Other Activities

Exposition will occupy 150,000 sq. ft. on the first and second floors of the Coliseum. Some 250 companies will display new equipment, technological developments and the latest ideas in engineering design and services.

Field trips offer you opportunities to visit the International Petroleum Exhibition in Tulsa, Okla., May 20-23, and other trips during the Congress to research centers, refineries and atomic power installations.

Hotel Accommodations

Rooms and suites in midtown hotels have been allocated for the use of the Congress. But it's important to make reservations before May 15, because after that the Hotel Reservation Bureau for the World Petroleum Congress (90 East 42nd St., New York 17) can't guarantee accommodations.

OIL CONGRESS TECHNICAL PAPERS

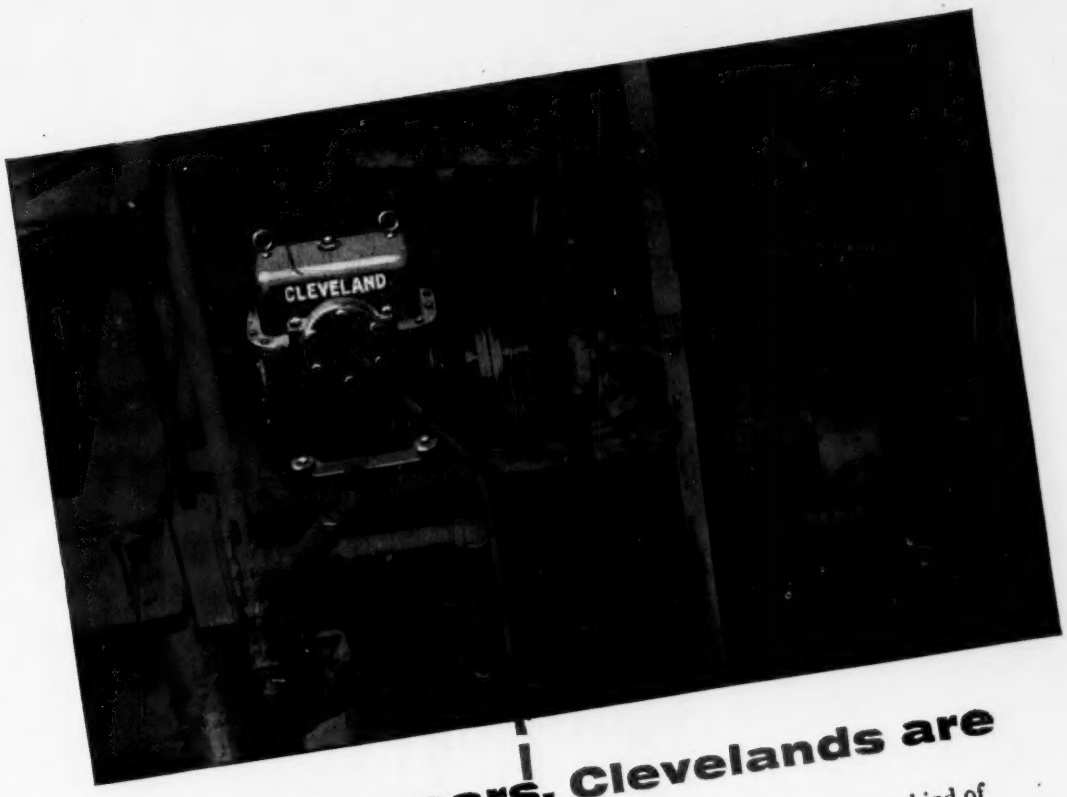
Paper No. • **Title**
Organization or author
Country • **Time given**

Drilling and Production

4. **Oil Shale — Energy for the Future.** Union Oil Co. of Calif. USA. **Mon. PM.**

13. **Automatic Production Control.** Imperial Oil Ltd. Canada. **Wed. AM.**

(*Continued on page* 184)



On the job 29 years, still going strong

Clevelands are

That's an enviable record for any kind of equipment . . . but not unusual at all for Cleveland drives. Eastern Corporation of Bangor, Maine, have several such drives in their various paper mills still using the original worms and gears.

And dependability is only part of the story. Clevelands are unexcelled in the smooth, vibrationless right-angle transmission of motor power.

Wherever you need such power, always specify Clevelands. For full details of the many types and sizes available, write for Bulletin 145.

The Cleveland Worm & Gear Company,
3275 East 80th St., Cleveland 4, Ohio.

Subsidiary of
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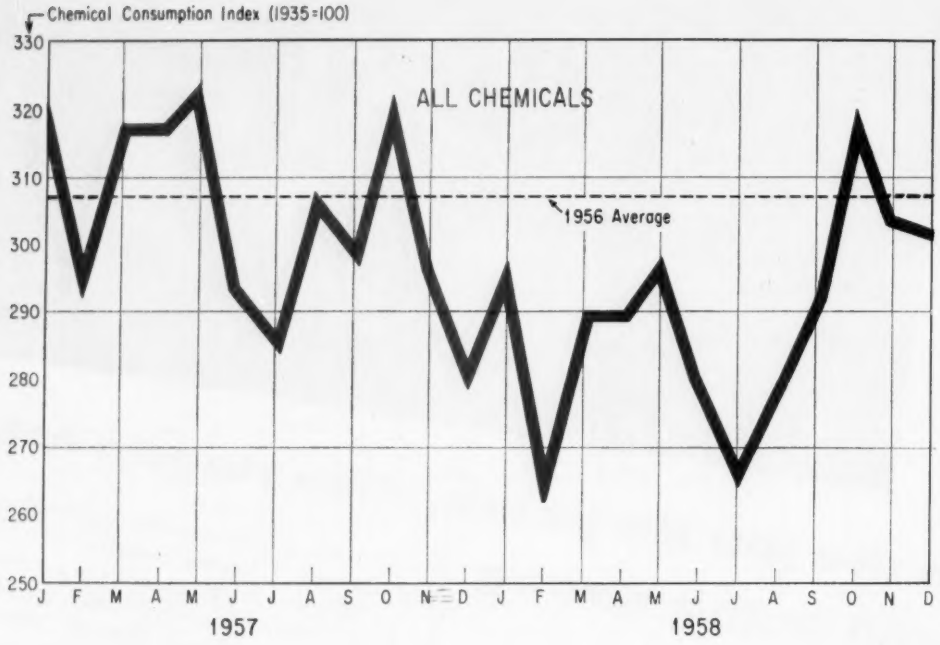
Worm Gear
Speed Reducers



How Chemicals Rode Out the Recession

Here's a recap of the recession's impact. It's based on *Chemical Engineering's* unique Index of Chemical Consumption by Industries.

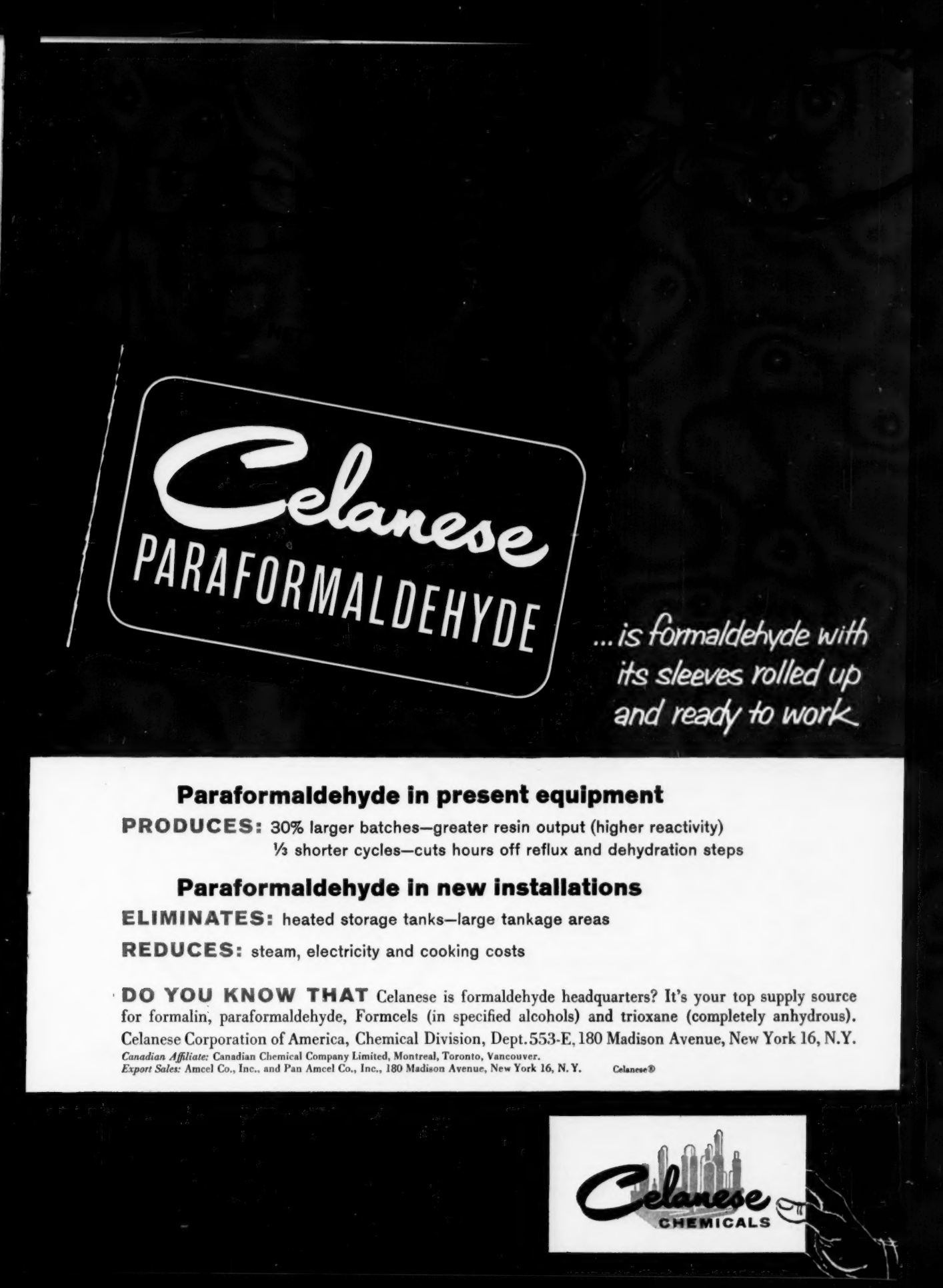
Chemicals were hard hit by sharp contractions in the activity levels of some of the biggest chemical-consuming industries during the recent business recession. Rubber, iron and steel, rayon, coal products, petroleum refining, textiles—all these big chemical markets operated well below par.

Yet some consumption areas—glass, fertilizers, pulp and paper, paint and varnish, plastics and explosives—held up quite well. And now that the weak spots in over-all chemical demand are noticeably stiffening, chemical makers are already experiencing a resumption of the pre-recession growth of their markets.

▶ **CE's Barometer** — *Chemical Engineering's* Index of Chemical Consumption stood at 302 (1935 = 100) in December of last year, its highest level for that month save for December 1955.

This is all the more remarkable when you consider that the average Index level for the full 12 months last year was only 291, well below any year since 1954. The CE Index was 306 in 1957, 307 in 1956 (the highwater mark) and 299 in 1955.

On the next two pages we



Paraformaldehyde in present equipment

PRODUCES: 30% larger batches—greater resin output (higher reactivity)
⅓ shorter cycles—cuts hours off reflux and dehydration steps

Paraformaldehyde in new installations

ELIMINATES: heated storage tanks—large tankage areas

REDUCES: steam, electricity and cooking costs

DO YOU KNOW THAT Celanese is formaldehyde headquarters? It's your top supply source for formalin, paraformaldehyde, Formcels (in specified alcohols) and trioxane (completely anhydrous). Celanese Corporation of America, Chemical Division, Dept. 553-E, 180 Madison Avenue, New York 16, N.Y.

Canadian Affiliate: Canadian Chemical Company Limited, Montreal, Toronto, Vancouver.
Export Sales: Amcel Co., Inc., and Pan Amcel Co., Inc., 180 Madison Avenue, New York 16, N. Y. Celanese®

Celanese CHEMICALS

show the recession course (1957-58) of ten of the biggest chemical markets, month by month. (Our regular Index includes three other chemical markets as well: explosives, coal products and leather.)*

▶ **Fast Windup**—Note, on these ten charts, how healthy the December 1958 Index figures are compared with the figures for the same month in 1956, the year with the best 12-month average ever.

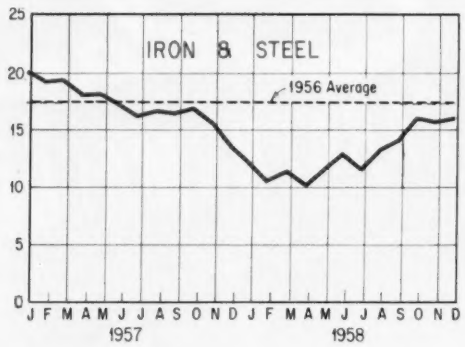
Fertilizer, pulp and paper, and paint and varnish indices of chemical consumption stand much higher. Even rubber and textiles, depressed by the business slump, are significantly higher at the end of 1958 than at the end of 1956.

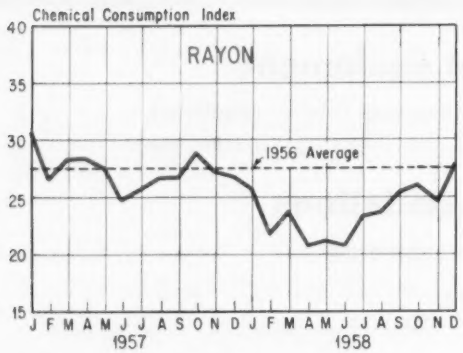
Chemical use in the glass industry is at least as well off in December 1958 as two years before. So is chemical consumption in the rayon industry, another particularly weak spot in recent years.

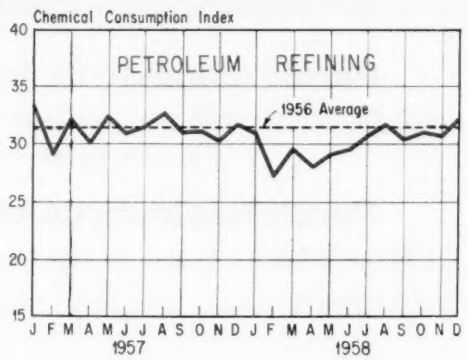
Chemical consumption in iron and steel and petroleum refining is still lagging behind the high-stepping pace of 1956. But the former has been making a

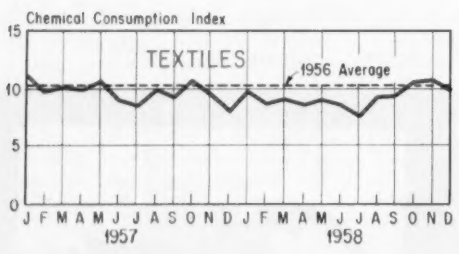
*In an upcoming issue we'll take you all the way back to 1949, showing the annual growth since then of each of the 13 biggest industrial markets for chemicals, which together make up our Index of Chemical Consumption.

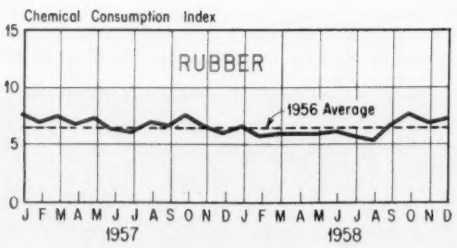
Caught in the business slump, these big industries cut back hard on their chemical consumption.









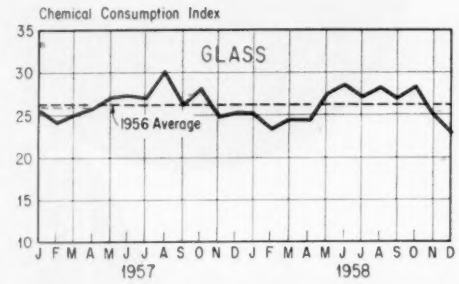


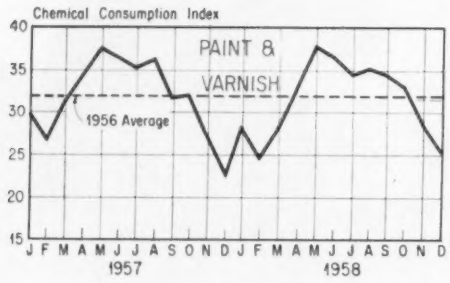
strong recovery drive in recent months and should be much better by midyear.

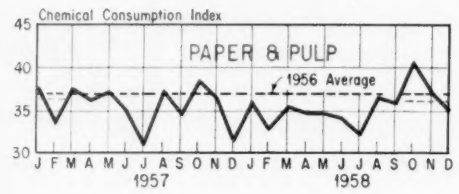
Last but not least is chemical demand from the precocious plastics industry, which stood higher in December 1958 than ever before in that month, and 24% above the level at 1956's end.

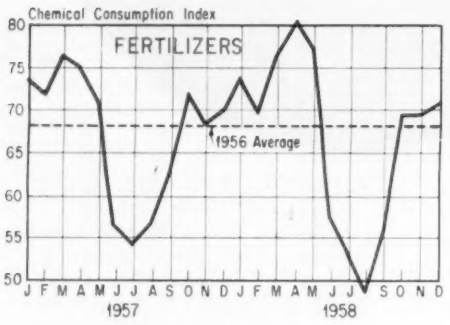
Now turn to page 201 ("Just Between Us") for more on the makeup and usefulness of *Chemical Engineering's* Chemical Consumption Index.

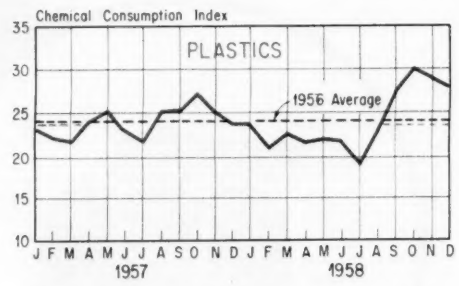
These industries, on the other hand, kept chemical-order books pretty busy right through the lean months.











Recession blunts big buildup in chemical use.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
1949	223	215	230	220	217	207	201	222	211	204	220	220	**216**
1950	231	217	255	248	261	253	239	267	254	273	260	264	**252**
1951	275	260	288	280	286	267	255	269	253	267	257	243	**267**
1952	261	261	269	263	257	239	230	267	266	288	265	265	**261**
1953	275	264	292	296	294	282	268	278	267	275	253	249	**274**
1954	262	253	289	277	270	268	240	255	255	277	274	276	**266**
1955	291	282	322	312	311	289	255	289	299	318	310	309	**299**
1956	333	325	340	320	326	297	250	282	287	320	311	296	**307**
1957	322	298	318	318	324	294	287	308	300	322	297	283	**306**
1958	**297**	**268**	**290**	**290**	**298**	**280**	**268**	**280**	**292**	**320**	**304**	**302**	**291**

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ABSOLUTE PRESSURE d/p CELL TRANSMITTER
with full-power 3-15 psi signal

Now there's a Foxboro d/p Cell designed specifically for low pressure measurement and transmission. It's the new Type 13AA Absolute Pressure Transmitter.

One side of the 13AA is evacuated, providing an absolute zero reference for the measurement of any process pressure. The 3-15 psi output signal has ample power for direct operation of standard receiver recorders and controllers.

This transmitter is simple in construction for trouble-free service. It provides for easy draining, steam tracing, and cleaning by regular maintenance procedures. Type 316 S.S. construction. Positive overrange protection to 1500 psi.

The 13AA Absolute Pressure Transmitter is ideal for use with such process equipment as low pressure fractionating columns, evaporators, and vacuum crystallizers. Ask your Foxboro Field Engineer for detailed information, or write for Bulletin 458-22A. **The Foxboro Company, 365 Neponset Ave., Foxboro, Mass.**

Specifications:

Range Spans: Adjustable 100 to 450 and 400 to 1500 mm of mecury

Output: 3-15 psi or 0.2 — 1.0 kg/cm^2

Accuracy: 0.5 percent of full scale span on most ranges

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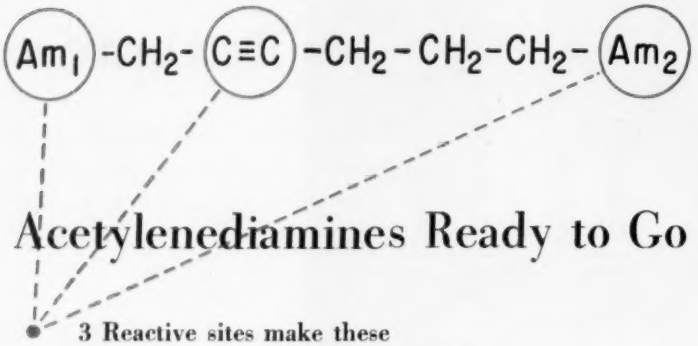


Acetylenediamines Ready to Go

3 Reactive sites make these new intermediates extremely versatile.

Today Aldrich Chemical Co. is well into the job of preparing its fall product catalog. And when that book hits the mails next September, it will be carrying a "commercially available" listing for the first time anywhere of a new family of highly promising chemicals—the acetylene-derived unsymmetrically substituted diamines developed by Lakeside Laboratories.

Lakeside has set up a semiworks manufacturing facility with a capacity rated at roughly 4,000 lb./yr. Presently, Aldrich is Lakeside's exclusive distributor of the acetylene-diamines, and is likely to hold that favored position for some time. However Lakeside reports that it's interested in licensing the process for making the diamines to other chemical manufacturers.

To begin with, Aldrich is offering as commercially available from stock six of the acetylenediamines, all diaminohexynes. But others are in preparation at Lakeside and, potentially at least, as many as 76 distinct acetylene-derived chemicals are in the offing, all producible by Lakeside's current plant and process. Price tag on the materials, putting them in the fine chemicals class, are $40/100 g. and $300/kilo. As volume markets develop, prices on the materials would fall considerably. However, there are limiting factors, notably the cost of certain key intermediates in the synthesis of the acetylenediamines. For example, the going price of propargyl bromide, available from such manufacturers as General Aniline & Film, is $13/kilo.

What is the basis for Aldrich's and Lakeside's confidence in the future of these new chemicals? In the words of Lakeside VP-Production Darwyn Kaestner, "These are unbelievably hungry compounds with a voracious appetite for other molecular fragments." Straight-chain multi-carbon molecules, the acetylenediamines have three highly reactive centers — an amine group on each end and an intermediate triple bond. With such centers available, literally hundreds of useful reactions can be carried out with each compound. As a result, the acetylenediamines suggest themselves as highly versatile intermediates to serve as basic building blocks for an astonishing variety of chemical syntheses.

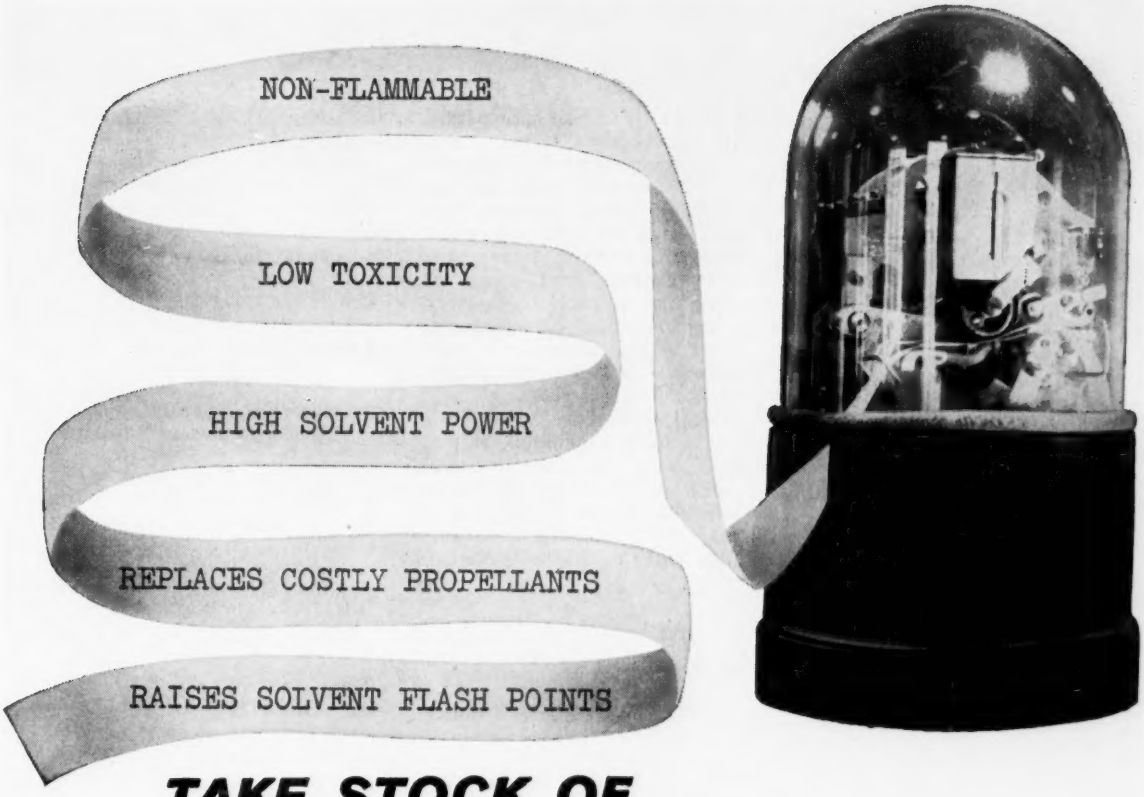
Among the most commercially promising applications for which Aldrich will be gunning in the immediate future are the manufacture of pharmaceuticals, plasticizers, new alcohol-type solvents, lubricating oils, various polymers, detergents, insecticides, herbicides, fungicides, plant-growth inhibitors and rust inhibitors.

To date, 19 diaminoalkynes have been synthesized and these basic compounds represent the gateway to a slate of corresponding diamino derivatives. For saturating the triple bond of these compounds, the corresponding diaminoalkene (when bond is reduced to a double bond) and diaminoalkane (when bond is completely saturated) can be produced. Furthermore, the corresponding alcohols, esters, and ketones can be made readily.—**Aldrich Chemical Co., Milwaukee, Wis.** 66A

Phthalocyanine Green

The line's right for St. Patrick thanks to first yellow-green phthalocyanine.

General Aniline & Film has developed what it describes as



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Your product or process may profit from properties combined in SOLVAY Methylene Chloride.

For example, its properties of high solvent power, non-flammability and low toxicity have resulted in its use in such diverse applications as paint removers, aerosols, safety-type photo film, extraction, industrial cleaning and to raise the flash points of flammable solvents. In aerosols, it replaces costlier propellants without lowering efficiency. Its high volatility and low water solubility make it an important extractant for heat-sensitive materials.

The physical properties listed here may suggest valuable uses in *your* operation. For a sample and further information, mail the coupon.

Physical Properties

Molecular Weight	84.94
Boiling Point	104.2°F. (40.1°C.)
Freezing Point	—142.1°F. (—96.7°C.)
Specific Gravity, 20/4°C.	1.326
Pounds per Gallon (20°C.)	11.07
Specific Heat of Liquid (20°C.)	0.284 cal./gm./°C.
Latent Heat of Vaporization (at B. P.)	78.7 cal./gm.
Flash Point	None
Vapor Pressure at 70°F	17.2 incnes Hg vacuum (—7.6 psig)
Vapor Pressure at 120°F.	5.4 psig

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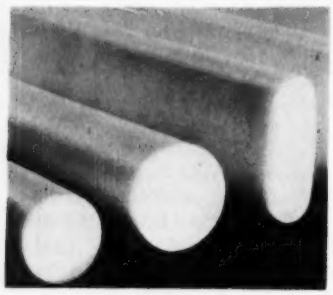
the yellowest green pigment available for producing vivid colors, free of the dichromatic effect often exhibited by mixtures of yellow and green pigments.

The product is a phthalocyanine and boasts the recognized advantages which phthalocyanines have been providing in the blue-green range for fields requiring light-fast, chemical-resistant colors.

GAF has been working on the product for ten years but declines to discuss chemical structure or their manufacturing methods.

Company is gunning for an eventual 8.5-million-lb./yr. market, about half of which would be in surface coatings. Called Heliogen Viridine, it will also be used to provide a wide range of shades in plastics, rubber, textile prints and inks.—**General Aniline & Film Corp., New York, N. Y.** 66B



Foamed Polyethylene

For flotation, fabricated parts like gasketing, packaging, thermal insulation.

A flexible, low density polyethylene foam has been placed on the market in limited quantities. The density is about 2 lb./cu. ft.—or 30 times lighter than water.

Development engineers say that flotation, fabricated industrial parts such as gasketing, packaging and thermal insulation, appear to be among major fields of application. Because the polyethylene foam displays high shock absorbing ability, it has good potential in impact packaging applications. The material is easily fabricated with power tools.

Other characteristics include: Low water absorption and low moisture vapor transmission rates, high solvent and chemical resistance at room temperature, light weight, good insulation value and no odor.

The foam may be adhered to itself by heat alone, or to other materials by commercially available adhesives. Coatings need special techniques.

The foam is available in 9-ft. lengths in two sizes of round stock, flattened ovals and untrimmed planks. The price is currently 22¢/board feet.—**Dow Chemical Co., Midland, Mich.** 68A

Rubber Accelerators

Now available in briquette form.

A new uniquely convenient briquette form of dry chemicals for rubber processing has been introduced by Monsanto. Santocure and Santocure NS, the company's delayed-action sulfenamide accelerators, now are available pressed into miniature, pillow-shaped briquettes measuring only a half-inch in length.

Larger than the usual industrial pellets but smaller than standard briquettes, the new dry form is reported to be exceptionally free flowing for maximum handling and weighing ease, both in automatic weighing machines and older types of equipment. Their apparent density is estimated to be 20% lower than that of powders.—**Monsanto Chemical Co., St. Louis, Mo.** 68B

Anti-Caking Agent

For coating hygroscopic chemicals, boasts superior covering power, adhesion.

Producers of fertilizers and other hygroscopic or sticky industrial chemicals will be interested in Attacote, a new fine particle size, sorptive Attapulgus clay specifically produced as an anti-caking agent.

Field tests indicate that the material is superior to many agents currently used for coating prilled, granular and explosives grade ammonium nitrate; ammonium sulfate; agricultural grades of urea; granular high-analysis fertilizers; and such resins as phenol-formaldehyde.

Magnesium aluminum silicate, Attacote is inert and nontoxic. Its low bulk density gives it high covering power and it has superior adherence properties. Its excellent desiccant properties, which stem from its needle-like particle structure and resulting large surface area, are credited with making it more effective then conventional coating agents.—**Minerals & Chemicals Corp. of America, Menlo Park, N. J.** 68C

Newsworthy Chemicals

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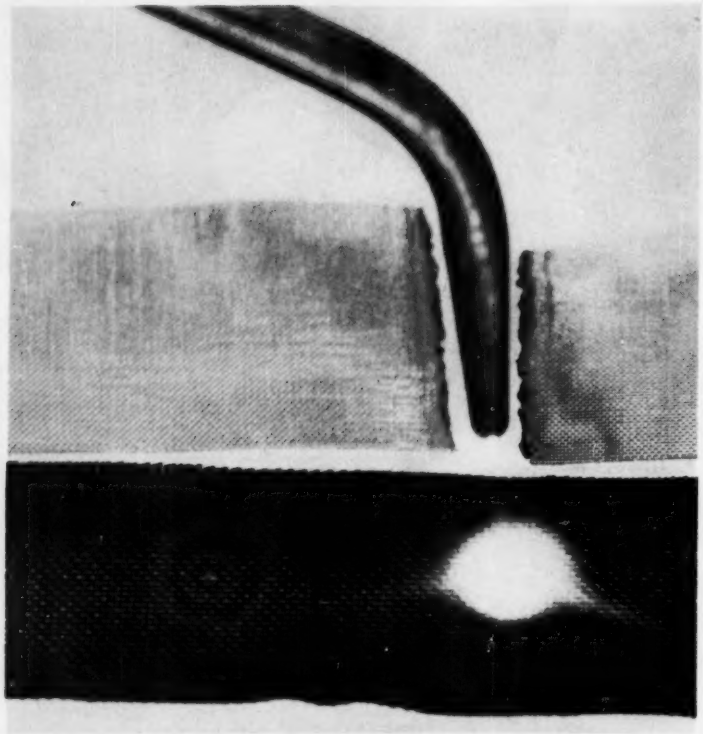

GRAPHITE CLOTH, unlike steel mesh, stands acetylene torch.

Fiber Stretches Graphite Use

Graphite can now be made in fiber form adding elasticity to traditional properties.

Excellent electrical and thermal conductivity, resistance to neutrons and all but highly oxidizing acids, alkalis, organic compounds and molten metals—all this traditional bounty of refractory graphite can now be coupled with startling flexibility and elasticity.

National Carbon Co., division of Union Carbide, has developed a process to convert organic textile forms directly to graphite with a purity in excess of 99.9%. Any textile form—yarns, braids, and felts, or fabrics that are woven or knit—can be produced in this unique material.

In addition to the properties of conventional manufactured graphite, graphite textiles have shown tensile strengths as high as 15,000 psi. Specific data on a typical form of graphite fabric, square weave, 28 x 28 construction: Typical surface area, 260 sq ft./sq. ft.; weight/sq. ft., 0.04 lb.; tensile strength, room temperature, 10-15 lb./in. width; electrical resistance, room temperature, ½ ohm./in. width/in. length. Initial production of experimental quantities of the 28 x 28 weave is $1.50/sq. ft.

One field in which experimental quantities of graphite cloth are being evaluated is as a reinforcing agent for various plastics and refractory materials used at high temperatures, such as in the nose cones of space materials. Graphite fibers and fabrics can be used to impart electrical and thermal conductivity to nonconducting materials such as plastics, ceramics and even to other textile materials such as glass cloth.

In chemical applications, graphite cloth of the proper mesh is being considered for bag type filters for hot nonoxidizing gases; for equipment to handle corrosive fluids; in electrostatic precipitators, curtain walls and flame arrestors.

Possible mechanical applications combine thermal properties with self-lubricity, and include valve packing and gasket materials for high-temperature seals such as those in jet engines. Conveyor belting for high-temperature process equipment is another possibility.

At ordinary pressures, graphite has no melting point, and sublimes only at extremely high temperatures (approximately 6,600 F.). Graphite has the unusual property of getting stronger at higher temperatures, and its tensile strength at 4,500 F. is about twice that at room temperature. Graphite oxidizes in air at temperatures in excess of 750 F. At the low end of the temperatures scale, the known properties of graphite fabrics are unaffected by liquid nitrogen at temperatures of −320 F.

In the complex production process, for which patents have been applied, a fiber of fabric such as rayon is carbonized by heat so that only 20% of the original raw material remains. It is then graphitized by electrically heating it to a temperature approaching 5,400 F.—**National Carbon Co., New York, N. Y.** **70A**

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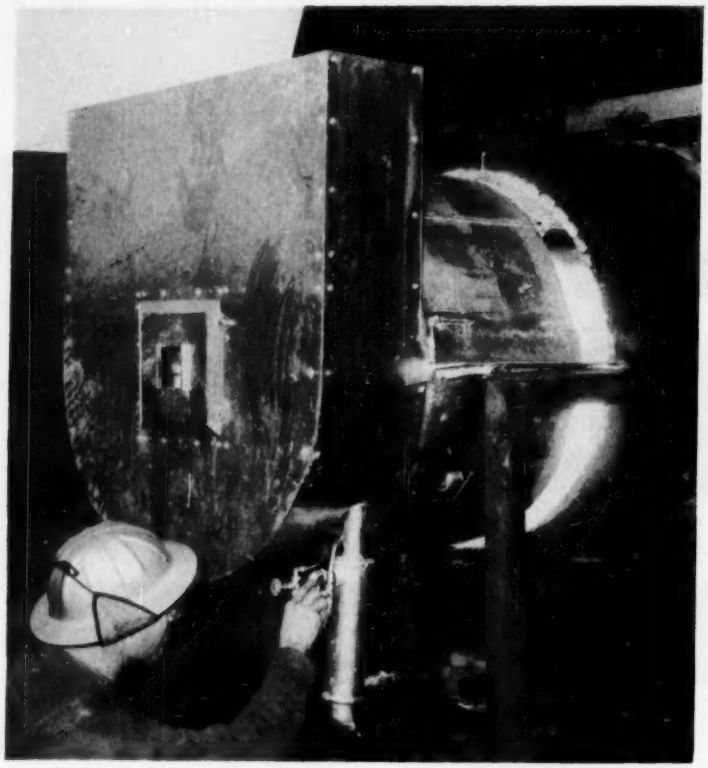

Industrial Burner Wrings Energy From Steam

Steam—the atomizing agent—dissociates to give free oxygen and burnable hydrogen.

Back in 1951, two men experimenting with a heating device in their garage noted that addition of water to their fuel always gave a hotter, brighter flame. Within no time, local press headlines blared: "Inventors Discover New Heater That Runs on Water!"

Although such sensational claims were obviously premature and unproved, the experimentation did lead to the development of a highly successful industrial burner, now marketed by Utah Hydro Corp. According to George Jackson, one of the two experimenters and now vice president of Utah Hydro, a patent has just been granted on the device.

Known as the Hydro Oil Burner, the unit performs best on the cheapest of fuels—the higher the carbon content, the better. Jackson says that present users report savings from 33 to 50% of former oil consumption. And, combustion in the burner is so complete that soot, carbon and smoke problems are nonexistent.

▶ **Dissociation May Be Key**—Hydro burners use steam as an atomizing agent. In operation, steam at 80-125 psi. enters a superheating steam coil in the burner's housing; the coil is fabricated of drawn stainless steel tubing. As the steam moves in a spiral path towards the discharge line leading to the burner nozzles, its temperature rises to about 1,000 F.

In theory, this high temperature, in combination with the low pressure within the combustion chamber, causes partial dissociation of the steam to hydrogen and oxygen. The hot gas-steam mixture then atomizes and thermally cracks the oil.

According to Utah Hydro, oxygen from the steam unites with carbon in the oil, and released hydrogen is burned, thus apparently increasing over-all burner output.

▶ **Applications Expanding**—So far, Utah Hydro has limited operations mainly to the Rocky Mountain area. Asphalt plants have been the biggest users. But interest is growing throughout the process industries.

For example, Union Carbide Chemical Co.'s Torrance, Calif., plant has put the burner through its paces. C. F. Van Valkenburgh, head of Carbide's Furnaces & Compressors Dept. says, "In preliminary tests, a ½-gpm. Hydro burner successfully burned a very viscous

There's one sure way to get intimate mixing of dry and semi-dry material on a continuous basis

Strong Scott

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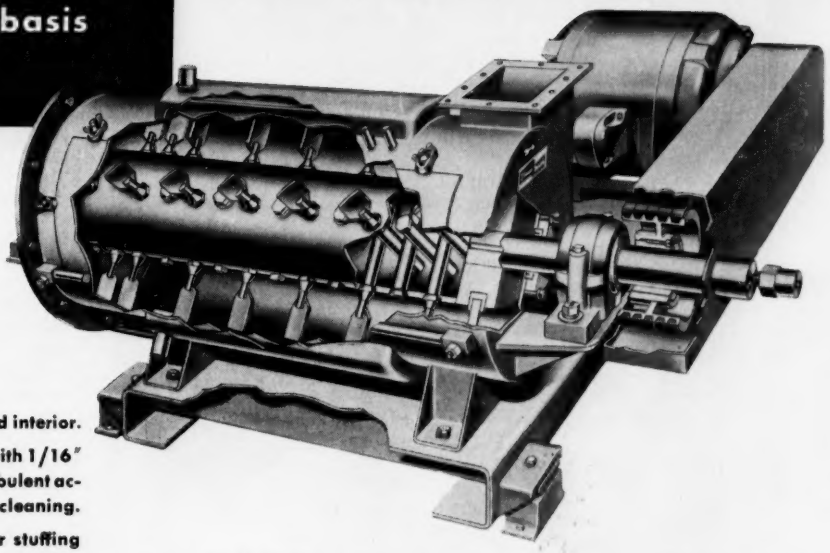

EXCLUSIVE TURBULIZER FEATURES

- Heavy steel shell with machined interior.
- Paddles revolve at high speed with 1/16" clearance to shell, creating a turbulent action that makes Turbulizer self-cleaning.
- Choice of lip type, air purge or stuffing box seals. All are of split construction for quick disassembly. (Lip type seal shown.)
- Hinged door is machined as an integral part of the shell giving a perfectly smooth interior surface.
- May be equipped with jacket up to 150 PSI for heat transfer medium.
- Hollow rotor shaft for heat transfer medium gives added temperature control.
- Inlet nozzles available for adding liquids.
- Quick acting heavy lug type catches—no nuts or bolts to remove.
- Tangential inlet and discharge prevent material hang-up.
- Heavy duty outboard bearings.
- Rotating joints for easy connection to heat transfer medium source.

The Turbulizer solves many dispersion problems in the chemical and food industries. Adjustable-pitch paddles, revolving at high speed, result in the combined action of turbulence, shear and impact providing intense dispersion. These actions can be varied to obtain desired results on a specific material.

A completely smooth inner surface with 1/16" clearance paddles, assures thorough mixing, eliminates material hang-up, leaves no dead pockets of unmixed material and provides a self-cleaning operation.

In addition to the numerous features shown here, advantages of the Turbulizer include better product uniformity, increased production, plus lower labor, installation and up-keep costs.

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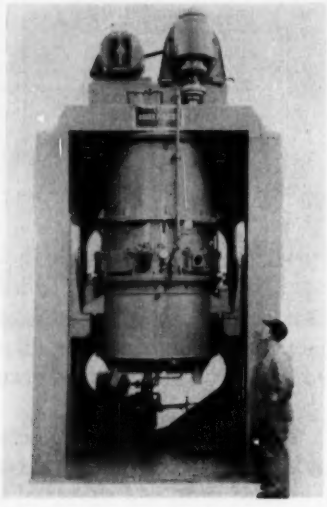
hydrocarbon sludge. Water content of the sludge varied between 40 and 60%. Test results showed that smoke density was well within acceptable limits for the Los Angeles area."

And at North Salt Lake, Utah, Western States Refinery is using a Hydro burner to heat oil en route to a fractionating tower (see photo p. 72). The unit is burning crude oil bottoms and excess gases; this installation gives off absolutely no smoke. According to the company, the burner has substantially increased throughput.

▶ **Take Your Pick**—Hydro Oil Burners come in sizes ranging from 18 to 300 gph. Steam requirement is 1 to 4 lb./gal. oil. —**Utah Hydro Corp., Salt Lake City, Utah.** **72A**



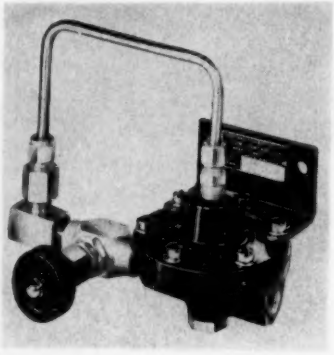
Planetary Mixer

No stuffing glands. Good for abrasive materials.

Although designed primarily for solid propellents, a new heavy-duty vertical planetary mixer may find other process-industry applications. Company officials say that the machine is especially suitable for mixing products that are abrasive, that are easily contaminated or that must be compounded in a vacuum.

One advantage claimed for the 40-hp., 22-ft.-high machine is complete elimination of stuffing glands in the mixing area. This drastically reduces maintenance and eliminates feedback.

Two stainless steel agitator blades operating at a differential speed of 2:1 do the mixing in a stationary stainless steel can. The can is jacketed for circulating water or steam at 80 psi. Having a working capacity of 150 gal., the machine is also useful for internal pressure mixing with some design revisions.—**Baker Perkins, Inc., Saginaw, Mich.** **74A**

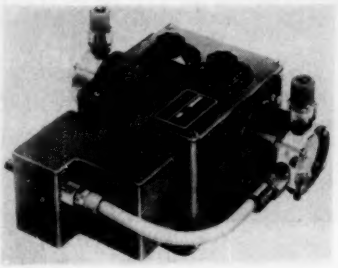


Flow Controller

For small flows of liquids or gases.

Moore Products Co. announces the recent development of flow controllers for use on liquid flows as low as 2 cc./min. or on air flows as low as 30 cc./min. Operating on line pressure, the new units provide a constant mass flow as a function of needle-valve setting.

Several factors, including the specific gravity of the fluid and applied operating pressure, determine rangeability and minimum controllable flow. Rangeabilities of 500:1 or higher are possible.—**Moore Products Co., Philadelphia, Pa.** **74B**



Slurry Feeder

Accurately pumps corrosive fluids, filter aids.

Designed specifically for diatomaceous-earth filter-aid slurries, Model 600 feeders offer rugged, maintenance-free operation and low initial cost. The automatically controlled clear-water flush system, an integral part of the pump, assures pumping dependability over the full output range of 0-2.5 gph. Output may be regulated while the pump is operating.

Model 600 is also applicable to complex chemical feeding requirements. For example, compined feeding of chlorine and sulfuric acid via one pump is possible by the addition of independently controlled heads. —**Precision Chemical Pump Corp., Waltham, Mass.** **74C**

Dissolved-Oxygen Meter

Accurate instrument provides continuous record.

Known as the Dissolved Oxygen Meter, a new instrument automatically measures and continuously records the dissolved-oxygen content of surface waters. Results are reported as percent of saturation, standard range being 0 to 150%.

Operating principle of the instrument is based on Henry's Law, which states that partial pressure of gas above a liquid surface, at equilibrium, is directly proportional to the

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EXCITING NEW PRODUCTS THROUGH PETRO-CHEMISTRY

ENJAY COMPANY, INC.

15 West 51st Street, New York 19, N. Y.

Akron • Boston • Charlotte • Chicago • Detroit • Los Angeles • New Orleans • Tulsa

ENJAY
PETROCHEMICALS

amount of gas dissolved in the liquid. The device has no moving parts and requires no reference fluids.

Instrument accuracy is better than ±2% of full-scale range. Analysis is not influenced by temperature, salt content, pollution, barometric pressure or dissolved nitrogen content.—**The Hays Corp., Michigan City, Ind.** 74D

Polymer Linings

Stop leakage from wooden tanks. Cut lining costs.

Lead, asphalt and brick, traditional linings for wooden tanks, may soon be replaced by a new polymer lining material. Tanks lined with the new product are said to be less costly for both labor and material than methods formerly used. In addition, the manufacturer claims that the new linings eliminate such difficulties as short life and leakage.

Choice of polymer varies with intended application. For example, polyvinyl chloride is available for handling most inorganic acids and bases, bleach and many organic solvents; polyethylene linings are best for solvents and inorganic solutions.

Installation is simple. Apply the liner loosely over the tank's surface and fasten it to the wood around the top; or carry the liner over the top and fasten outside. When necessary, the lining can be cemented to the tank. Liner sleeves are available for fittings passing through the tank's wall.—**Wendnagel & Co., Inc., Chicago, Ill.** 76A

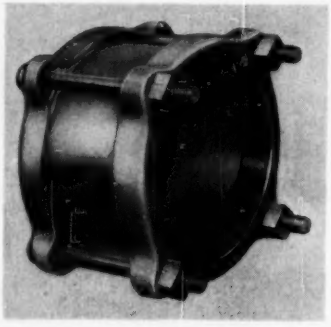
Centrifugal Pumps

Lined for resistance to acids and alkalis.

A new line of centrifugal pumps rated at ½ to 20 hp. is available for capacities of 10 to 1,200 gpm. at heads of 15 to 20 ft. Standard lining is an acidproof, semihard rubber that is suitable for all alkalis and acids (except nitric and chromic) at temperatures to 210 F. Other synthetic lining materials are optional.

All models are so constructed that no metal contacts the fluid being pumped. A one-piece cast iron head incorporates both suction and discharge nozzles — disassembly does not disturb piping.

A nonleaking mechanical seal, cooled by the fluid being pumped, is standard. — **Carl Buck & Associates, Essex Falls, N. J.** 76B



Aluminum Couplings

Are 60% lighter than steel units; strong.

Available in sizes from 2 to 6 in., low-cost aluminum couplings permit up to 6 deg. pipe deflection, handle working pressures up to 150 psi. and safely absorb vibration, expansion-contraction and other piping stresses.

Style No. 38 aluminum couplings consist of one cylindrical middle ring, two follower rings, two resilient gaskets and a set of steel bolts. Tightening of the bolts draws the follower rings towards each other, compressing the gasket to form a flexible, leakproof seal.—**Dresser Mfg. Div., Bradford, Pa.** 76C

Heat Meter

Keeps tabs on heat transfer in process equipment.

Primarily designed for measuring heat transfer in hot water generators, cooling towers and refrigeration systems, a new heat meter continuously records, indicates and integrates Btu. loss or gain of a flowing liquid. Temperature differential and flow rate of the liquid are also recorded on the same chart.

Two platinum resistance elements, one for liquid inlet temperature, and the other for outlet, form two legs of a resistance bridge for which the differential temperature receiver of the recorder acts as a rebalancing unit. A Model 245 flow transmitter measures flow through the equipment.—**The Hays Corp., Michigan City, Ind.** 76D

Density Gage

Employs nuclear radiation. Accurate and stable.

A new noncontacting radiation gage continuously measures the density of liquids, gases, slurries and powders moving in pipes, tubes and other conveyors. Designated as BG-3, the gage employs direct a.c. amplification, is highly stable and will measure with a resolution of ¼% over a range of 0.5-1.05 g./cc.; accuracy is ±1%.

Only the small, compact measuring head, containing both radiation source and detection

EQUIPMENT NEWS Continues on . . . Page 178

Beautiful specimen of Nature's handiwork: Sulphur Crystal embedded in the matrix of limestone and calcite crystals recovered from a drill core taken hundreds of feet underground while exploring a Sulphur deposit. (Ektachrome by Keturah Blakely)

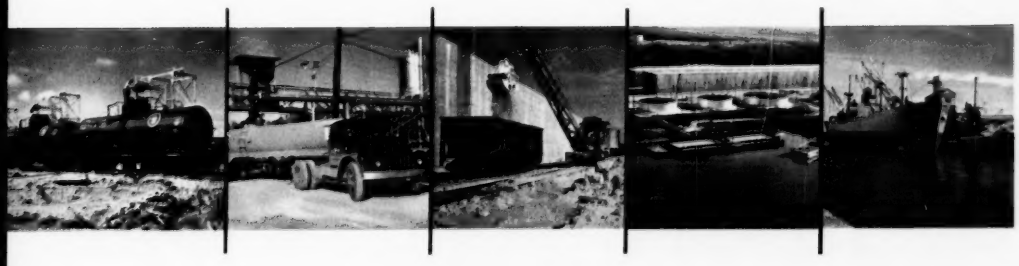
from the company that is Staffed, Equipped and Stockpiled for Service

Solid Sulphur by Rail, Barge, or Ship

Molten Sulphur by Rail, Truck or Barge, from Mines or Strategically Located Terminals

Technical Service on problems involving the Use and Handling of Sulphur

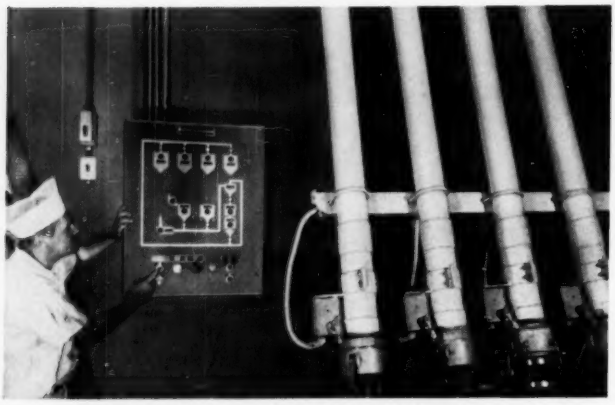
SULPHUR



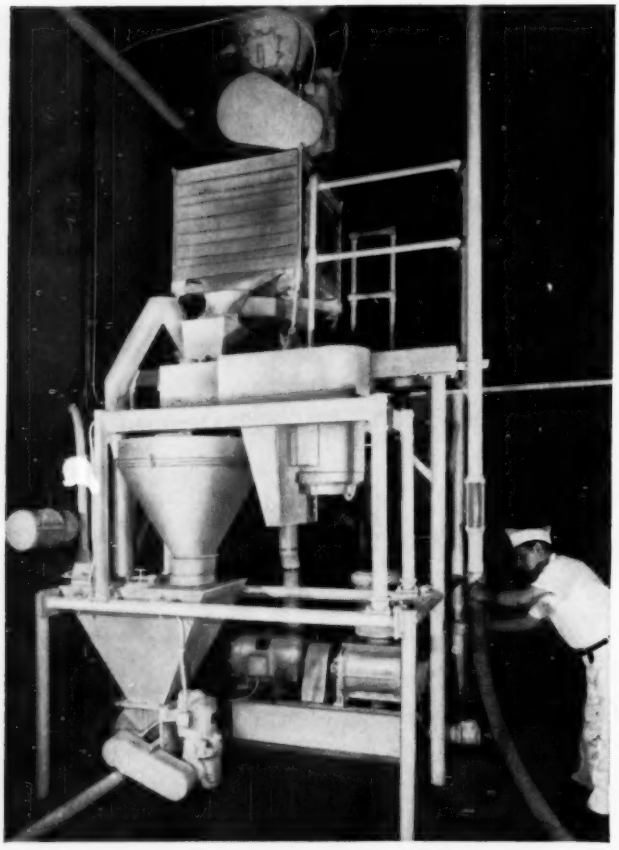
from left to right:
Loading Tank Cars with Molten Sulphur
Loading Tank Trucks with Molten Sulphur
Loading Gondolas with Solid Sulphur
Loading Barges with Molten Sulphur
Loading Freighters with Solid Sulphur

TEXAS GULF SULPHUR CO.
75 East 45th Street, New York 17, N. Y.
811 Rusk Avenue, Houston 2, Texas
Sulphur Producing Units: Newgulf, Texas • Spindletop, Texas • Moss Bluff, Texas • Fannett, Texas • Worland, Wyoming

The Arithmetic of Materials Handling



Central Control Panel of Jewel Tea's flour-handling system. At right are main conveying lines—each to a separate bin.



FULLER

Pneumatic Conveying System Provides Low Cost, Sanitary Flour Handling Method For New Jewel Tea Co., Inc. Bakery

Automation . . . at the new Jewel Tea Company bakery in Melrose Park, Ill., . . . means baking more than four tons of bread an hour under the highest standards of sanitation, at the lowest possible production cost. A Fuller-engineered *pneumatic* flour-conveying system helps make this record performance possible.

This automatic, smooth running pneumatic conveying system is controlled by one man and a centrally located push-button control panel. By making a simple connection, turning a switch and pressing a button, the operator empties 100,000 lb. GACX Airslide carloads, of bulk flour, into storage bins. Other buttons send the flour through predetermined cycles of sifting, weighing, mixing — in dust-tight, self-cleaning pneumatic lines.

Compact, flexible, easy-to-install Fuller pneumatic conveying systems are *integrated* into your plant processed by Fuller specialists. Write or phone today outlining objectives such as capacity, distance and material to be handled. Fuller engineers will gladly furnish additional information and make appropriate recommendations.

1308
A-273

For details on the Fuller product line, see Chemical Engineering Catalog

FULLER COMPANY GENERAL AMERICAN TRADE MARK

Fuller
. . . . pioneers in harnessing AIR

FULLER COMPANY
134 Bridge St., Catasauqua, Pa.
SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORPORATION
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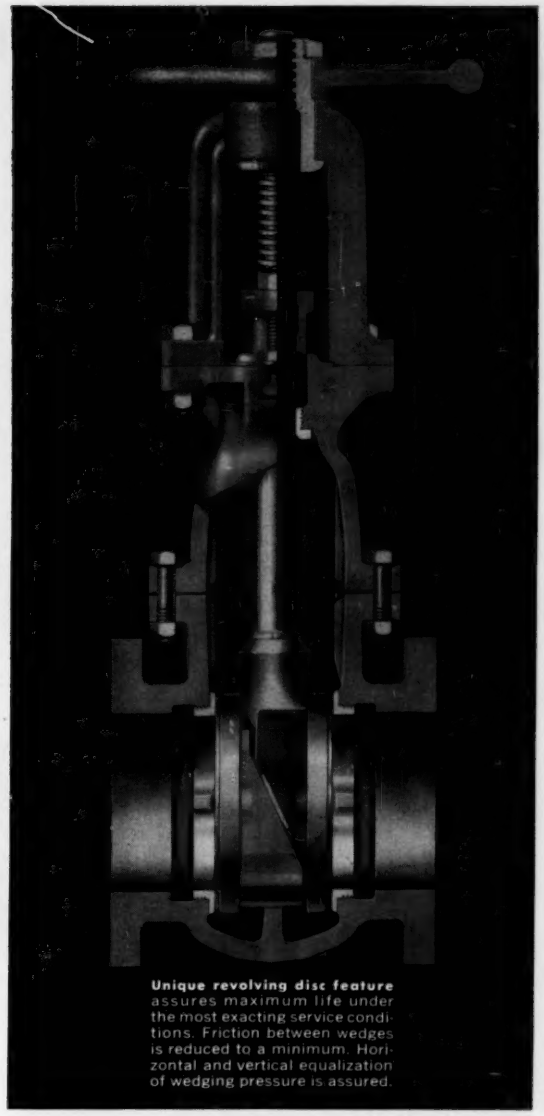
FOR SEVERE CORROSIVE CONDITIONS

Specify

ALUMINUM GATE VALVES

by Darling



Unique revolving disc feature assures maximum life under the most exacting service conditions. Friction between wedges is reduced to a minimum. Horizontal and vertical equalization of wedging pressure is assured.

Handling corrosive chemicals such as hydrogen peroxide, ammonium nitrate, acetic acid, concentrated nitric acid? Darling Aluminum Gate Valves give you longer life, cut maintenance costs, under these and other severe service conditions. Here's why:

Darling metallurgical engineers have thoroughly tested and standardized on the most highly corrosion-resistant aluminum alloys in use today.

Accurate casting control and precision assembly reduces friction and wear, provides maximum ease of operation.

Darling Double Disc Parallel Seat principle assures freedom from leakage, trouble and downtime.

Darling aluminum alloy valves are available in sizes from ½" through 24". Write us about your requirements and service conditions.

DARLING VALVE & MANUFACTURING CO.

Williamsport 3, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.

DARLING VALVES

Trapping Standardization

. . . steam trap standardization plus standardized hook-ups spell lower maintenance costs

An important weapon in the fight against rising maintenance costs is standardization. It can reduce the variety of maintenance problems and simplify those which remain.

Since we specialize in steam traps we'd like to offer some suggestions for a trapping standardization program. Such a program involves standardization on one make of trap and standardization of hook-ups.

Trap Standardization

The advantages of standardizing on a single make of trap are important and can make a big difference in the cost and ease of repairs because—

1. You can carry a more complete stock of repair parts with a smaller inventory.

2. Maintenance personnel has the opportunity to become expert on one make rather than be "jacks of all traps."

3. As an exclusive user of one make of traps you become a preferred customer of your trap representative and can be sure of getting the best possible service.

4. You can enjoy the advantages of standardized hook-ups.

Standardized Hook-ups

Standardized hook-ups facilitate and reduce the cost of both original installation and maintenance. By adopting standards for the dimensions of all fittings, including nipples, each hook-up for a given size of trap is identical and can be fabricated in the pipe shop.

Unions should be used so that when a trap needs repair, the unions can be uncoupled, the trap lifted from the line and a spare carrying identical length nipples and half unions slipped into place. In as little as a minute or two a faulty trap can be replaced. The faulty trap can go back to the storeroom for repair when convenient and then be put into stock as a spare.

Figure 1 shows a typical standardized hook-up used by a major chemical manufacturer. Note how

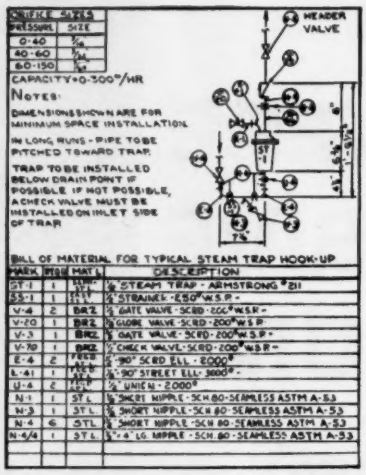


Fig. 1—Typical standardized installation hook-up used by a leading chemical manufacturer.

the hook-up provides the following advantages:

1. Test valve in trap cap permits fast, easy checking of trap operation.

2. Strainer ahead of trap protects it against dirt and scale.

3. Blowdown valve in strainer provides easy cleaning.

4. Check valve in discharge line isolates trap when test valve is opened.

5. Shut-off valves and unions ahead of and following trap permit removal of entire trap from line.

Fig. 2—Armstrong traps have only two moving parts—the lever assembly and the bucket. Nothing much to go wrong here.

Another important consideration for getting the most from a standardization program is accessibility of the traps. Insofar as is possible, traps should be located so that they are convenient for inspection. The easier it is to locate and get at a trap, the less likelihood that it will be overlooked.

What Make of Trap? (This is the Commercial)

Obviously, a trap standardization program shows the best results when the make of trap selected is the one that gives the best service. Naturally, we think the make should be Armstrong and fortunately a lot of trap users agree. Here are some of the advantages of standardizing on Armstrong that have been pointed out by these users:

1. *Armstrong traps work.* They don't leak steam and they do discharge condensate and air as fast as they reach the trap. And they work with any return system.

2. *Armstrong traps aren't "prima donnas."* They need no special care or coddling. Valve and seat are hardened chrome steel. Lever assembly and bucket are stainless steel and these are the only moving parts.

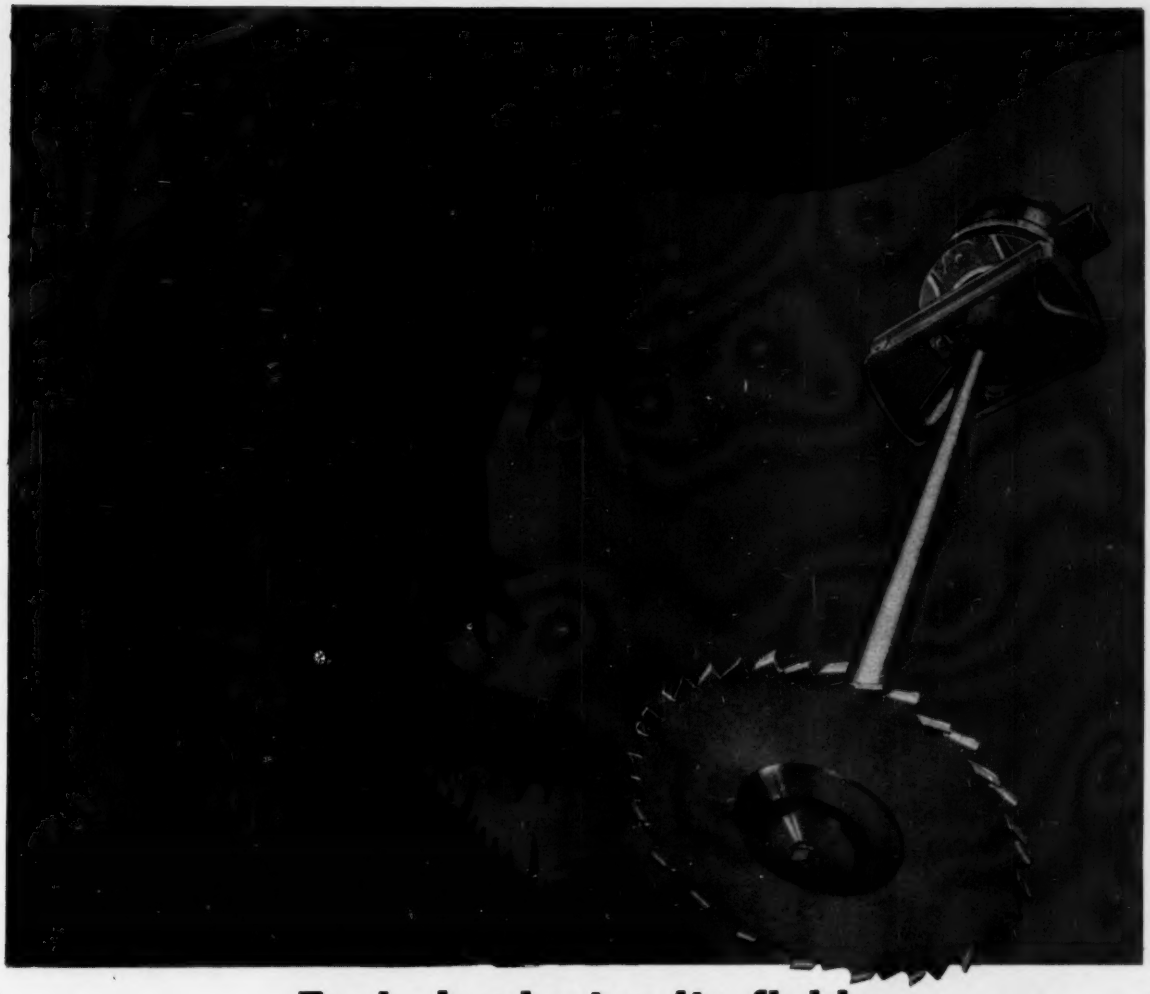
3. *Armstrong traps aren't "orphans."* You can *always* get parts and service from nearby Factory Representatives and stocking distributors.

4. *Armstrong traps are guaranteed.* If you're not *completely* satisfied you can return the traps for refund of purchase price.

More Information

The 44-page Steam Trap Book (free on request) gives a lot more facts on trap selection and installation. Call your local Armstrong Representative or write **Armstrong Machine Works, 8585 Maple St., Three Rivers, Michigan.**

ARMSTRONG STEAM TRAPS



Each dominates its field—
With "the teeth that make the big difference"

In high speed dispersing with the Cowles Dissolver, those "teeth" mean greater volume, higher quality, complete control—in less space and at lower cost. It's because the unique teeth of the patented Cowles Impeller give the most effective mixing action yet developed. And Cowles scientifically engineered power and drive systems assure you of maximum horsepower delivery—with operational ease at all impeller speeds.

Cowles' exclusive "Multi-Phase" mixing action makes it most in demand for ultimate dispersion, dissolving, emulsifying and deagglomerating in processing solid-liquid, liquid-liquid and gas-liquid materials. Even viscosities in excess of 50,000 centipoises are easily handled by the Cowles. There is no surge, no splash. Easy to clean, too, and the self-cleaning impeller won't clog—you'll save on operator time.

Cowles engineers will be happy to work with you in adapting the Cowles to your materials, processes and present equipment. They can help solve your processing problems economically.

Let us prove it in your plant—at our risk.

SEE HOW THE COWLES IS SOLVING THESE PROBLEMS:
(Cases from Cowles APPLICATIONS ENGINEERING files)

Vinyl Solutions in ½ the time
(1-G) *A special, patented Cowles Impeller is reducing per-batch time to only 2 hours. Previous methods required 4 hours. For many materials the Cowles can multiply volume up to 2-½ times.*

In-place Rug Padding Is New!
(1-H) *Amazing results in production of the revolutionary new foamed in-place rug padding compounds are reported for the Cowles. In a single operation, many dry materials are dispersed to ultimate particle size, let down to finished rug backing and pumped directly to tank trucks for delivery to rug manufacturers. (They foam the compound directly onto regular rug backing, thus eliminating the old separate pad). With the Cowles, one plant is now set for 200,000 gallons per month! Here's a great example of Cowles versatility in taking over on new problems.*

Blunging Clay Body Speeded 1250% **(1-J)** *In a dinnerware plant, 500 gallon batches are now blunged via Cowles in ¾ hrs. Operation used to take 6 hours. And the Cowles in combination with the Morehouse Mill completes job of both blunging and milling in 1 hr. vs. old method with ball mill that previously took 8-24 hrs.*

Starch Cooking Simplified
(1-K) *The Cowles acts as a completely self-contained homogenizing unit to produce finished batches of starch in an amazingly short time. 20 minutes for small batches, 1 hour for 250 gals., 2 hours for 2000 gals. are routine times. Report says no maintenance problems, no expensive repair parts, small power consumption.*

Teflon Dispersions High as 90%
(1-L) *In the plastics industries the Cowles is regularly handling teflon dispersions in concentrates as high as 80-90%. Batches are completed in 45 min. Again, speed and thoroughness hand in hand.*

MOREHOUSE COWLES

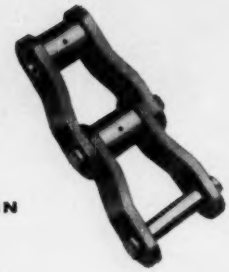
Write today for complete information and catalog.

MOREHOUSE-COWLES, INC., 1150 San Fernando Road, Los Angeles 65, California

REPRESENTATIVES IN PRINCIPAL CITIES • CONVENIENT LEASE AND TIME PAYMENT PLANS

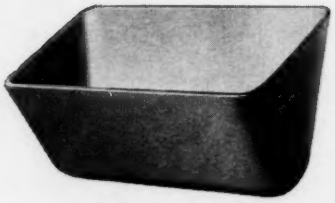
5906

CHAIN



BELT IDLERS

Jeffrey equipment stocked for shipment

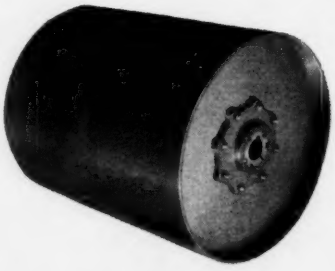


BUCKETS

SPROCKETS

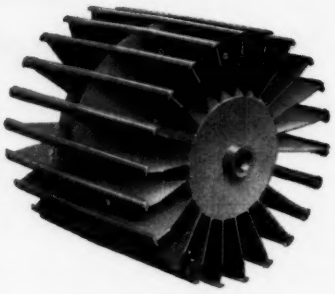
From factory or distributor stocks you can get fast service on a host of Jeffrey products...for elevating and conveying machinery and many industrial applications.

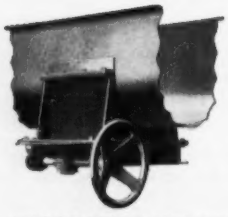
When replacing parts or modernizing machinery, it's wise to use genuine Jeffrey equipment. Highest manufacturing standards, based on years of experience, assure dependable performance. For service, call your Jeffrey distributor or write The Jeffrey Manufacturing Company, 909 North Fourth Street, Columbus 16, Ohio.



PULLEYS

PILLOW BLOCKS



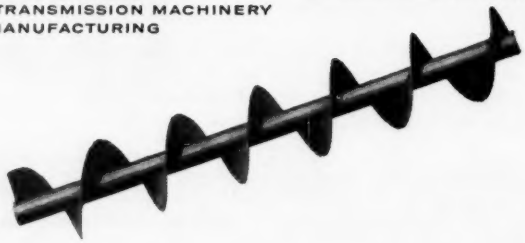


DISCHARGE VALVES

JEFFREY

CONVEYING • PROCESSING
MINING EQUIPMENT. . .TRANSMISSION MACHINERY
CONTRACT MANUFACTURING

SPIRAL CONVEYORS



COPPUS BLUE RIBBON PRODUCTS

Coppus Steam Turbine with Built-In Speed Reducer

STAMINA — You can literally *see* stamina in every dimension of a Coppus Turbine . . . rugged reliability that assures you stable, positive performance. It truly "wins" the Blue Ribbon with which it is marked . . . through advanced design, top quality materials, and thorough testing. With Coppus you're always certain of Blue Ribbon features such as these —

A totally enclosed governor . . . totally enclosed, independently operated safety trip . . . easily replaceable packing and bearings . . . multiple steam nozzle control . . . brake rim for added safety . . . wide bucket "L" type wheel (optional) for minimum water rate.

Coppus Turbines are built to customers' specifications, including API and NEMA standards. Sizes from 1 HP to 250 HP. All Coppus Products carry the same Blue Ribbon assurance of reliable performance. For further facts on turbines, send for new Catalog 200. COPPUS ENGINEERING CORPORATION, 226 Park Ave., Worcester, Mass. Sales Offices in *Thomas' Register*.

COPPUS
STEAM TURBINES

How to beat the high cost of temperature control

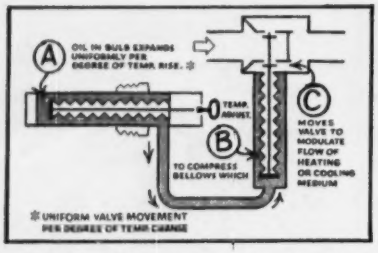
The practical approach to temperature control

By John W. Ritter, Test Engineer, SARCO Company, Inc.

Precise temperature regulation is essential in many processing operations, not only for quality control, but for maintenance of output as well.

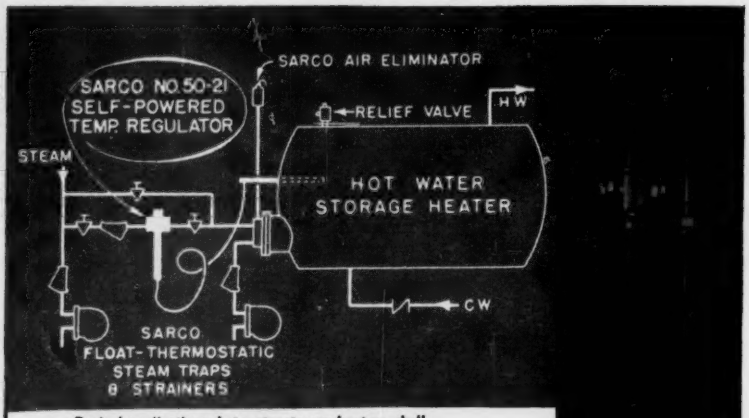
Manual temperature control is unsatisfactory because of the possibility of spoilage and loss of quality control which can result from irregular or indifferent hand regulation.

Automatic controls are available in a wide variety, including pneumatic, electronic, and self-powered. Pneumatic and electronic controls are relatively expensive to purchase and install, and may require frequent maintenance. However, in most applications, control requirements can be achieved very successfully by the use of relatively simple, economical Sarco Self-powered Regulators.



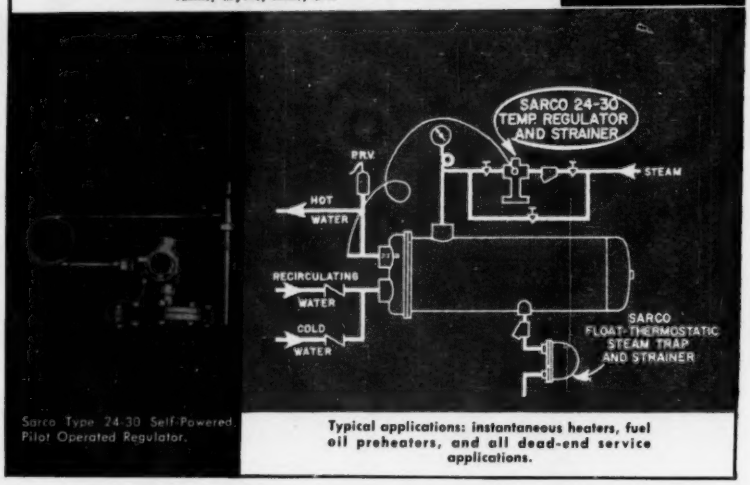
This drawing shows simplicity of operation of the Sarco 50-21 Temperature Regulator, which consists of a thermostat, capillary tubing, and a valve.

Sarco controls, like the 50-21 and the 24-30, have the required degree of sensitivity and dependability, combined with the ruggedness inherent in the sealed capillary tube construction. Because these Sarco controls do not depend on external power, such as electricity or compressed air, they have established long records of sustained, reliable operation. They are an economical and practical solution to the problem of maintaining continuous watchdog duty over processing temperatures.



Typical applications: hot water storage heaters, shell and tube heat exchangers, condensers, oil storage tanks, dryers, kilns, etc.

Sarco Type 50-21 Self-Powered Regulator.



Sarco Type 24-30 Self-Powered, Pilot Operated Regulator.

Typical applications: instantaneous heaters, fuel oil preheaters, and all dead-end service applications.

Self-powered automatic temperature regulators by SARCO . . .

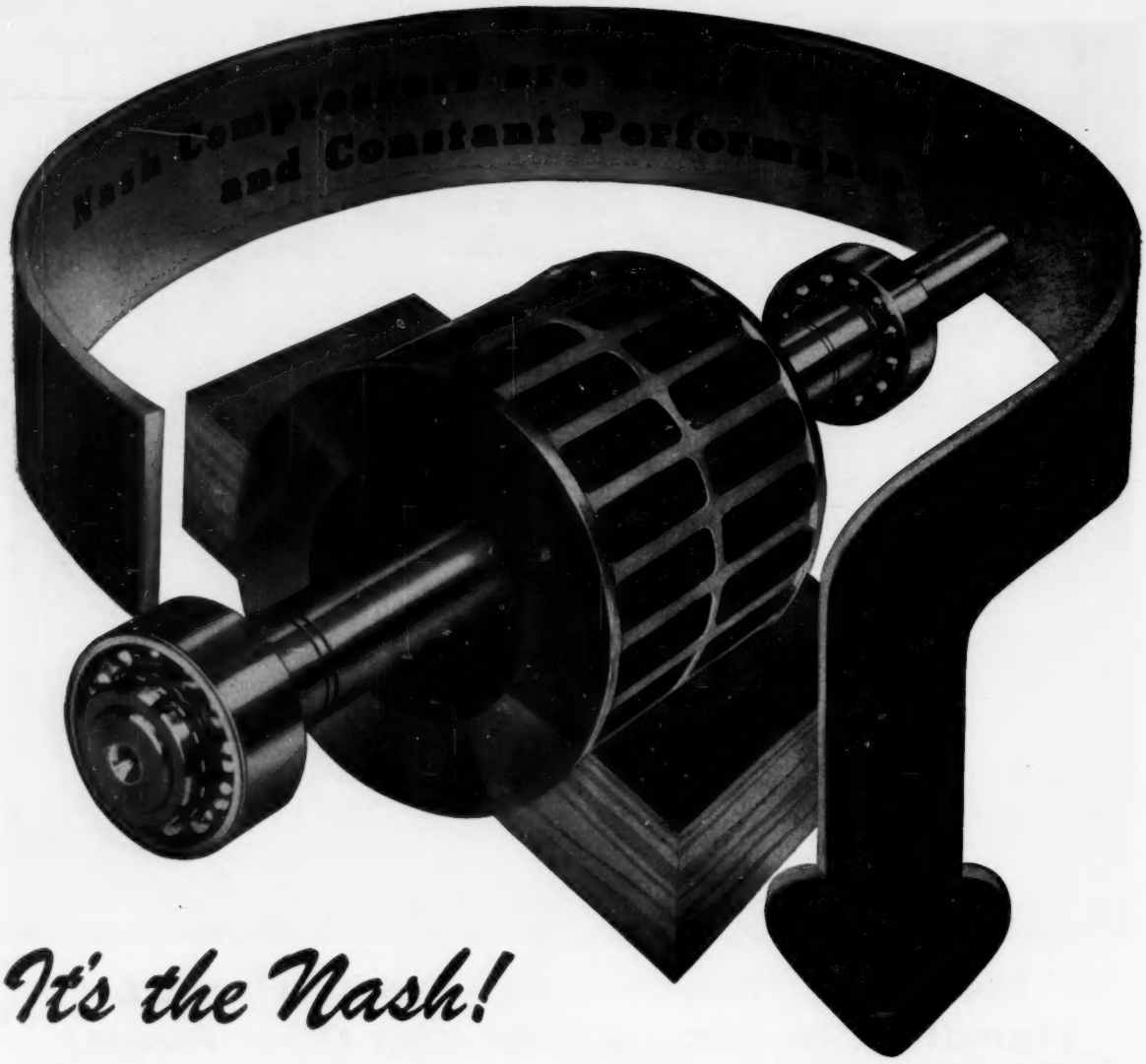
have these 5 marked advantages: No compressed air or electrical wiring required. No delicate mechanisms to adjust or maintain. No packing glands to stick or require maintenance. No shutdown during power failure. No specialized maintenance required.

Sarco Self-Powered Controls are self-contained and can be installed by any pipe fitter. They are so reasonable in cost that you can afford Sarco automatic heating controls for every application in your plant. Write for 10-page Sarco Control Bulletin No. 620.

6346-B

SARCO
COMPANY, INC.
635 Madison Ave., New York 22, N. Y.

STEAM TRAPS • TEMPERATURE CONTROLLERS • STRAINERS • HEATING SPECIALTIES



It's the Nash!

The ability of Nash Compressors to maintain original performance over long periods is no accident. Nash Compressors have but a single moving element, the Nash Rotor. This rotor is precision balanced for long bearing life, and it revolves in the pump casing without metallic contact. Internal lubrication, frequent cause of gas contamination, is not employed in a Nash. Yet, these simple pumps maintain 75 lbs. pressure in a single stage, and afford capacities to 6 million cu. ft. per day in a single compact structure.

Nash Compressors have no valves, gears, pistons, sliding vanes or other enemies of long life. Compression is secured by an entirely different principle of operation, which offers important advantages often the answer to gas handling problems difficult with ordinary equipment.

Nash Compressors are compact and save space. They run without vibration, and compression is without pulsation. Because there are no internal wearing parts, maintenance is low. Service is assured by a nation-wide network of Engineering Service offices. Write for bulletins now.

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

Desired delivery temperature Automatically maintained.

Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY

312 WILSON, SO. NORWALK, CONN.

Progress Report...

Making latex paints easier to use

Additives help those popular latex paints go on easily and spread well. Additives also increase shelf life in warehouse or store, improve pigment distribution, and give better resistance to temperature changes.

One important, effective thickener for latex paints is water-soluble, nonionic CELLOSIZE Hydroxyethyl Cellulose 4400. Paint processors get better production schedules with CELLOSIZE HEC, because it goes into solution easily and quickly, and has low-foaming characteristics. It is possible to add CELLOSIZE WP-4400 directly to the pigment grind, and thus avoid preparation of a separate thickener solution. Clear, bright colors are obtained because color variations are eliminated or greatly reduced.

Stable viscosity, good scrub resistance and excellent flowout are other desirable features of latex paints compounded with CELLOSIZE WP-4400.

For more information on thickeners, plasticizers, dispersants, stabilizers, and other CARBIDE additives, check the coupon to get the booklet, "Chemicals for Resin Emulsions."

Nonionic detergents from ethylene oxide

Continuing demands for low-foaming detergents call for another look at ethylene oxide as an economical base for nonionic surfactants.

No newcomer to the field, CARBIDE's ethylene oxide has been the starting point for various nonionic surfactants for more than 20 years. Powdered or liquid detergents, for light or heavy duty, can be produced from ethylene oxide derivatives. Such compounds have excellent wetting properties, ability to disperse grease, and a tendency to stabilize foaming. Nonionics derived from ethylene oxide with other reactants are stable in acid or alkaline aqueous systems and are compatible with both anionic and cationic surfactants.

Two types of surfactants can be produced by reactions involving ethylene oxide. Surface active esters result from reacting ethylene oxide with tall oil or rosin acids, or other hydrophobic acids:–

$$RCOOH + x(C_2H_4O) \rightarrow RCOO(C_2H_4O)_xH$$

Ether surfactants are made by the reaction of ethylene oxide with alkylphenols, higher aliphatic alcohols, mercaptans, or propylene oxide polymers:–

$$R\langle\rangle OH + x(C_2H_4O) \rightarrow R\langle\rangle O(C_2H_4O)_xH$$

$$ROH + x(C_2H_4O) \rightarrow RO(C_2H_4O)_xH$$

$$RSH + x(C_2H_4O) \rightarrow RS(C_2H_4O)_xH$$

$$x(CH_3C_2H_4O) + y(C_2H_4O) + ROH \rightarrow RO(CHCH_2O)_x(C_2H_4O)_yH$$

$$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\quad |$$

$$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\quad CH_3$$

Applications for detergents produced from ethylene oxide are found in domestic washing machines and dishwashers, utensil cleansers, and scouring compounds. Commercial establishments use them for large volume laundering, dry cleaning, rug and upholstery cleaning, restaurant dishwashing, and for scrubbing large surfaces.

Information on (1) handling and operating methods when using ethylene oxide, (2) data on TERGITOL nonionic surfactants for detergents, and (3) a 64-page booklet on ethers and oxides is available. Check the coupon.

How quality is maintained at CARBIDE

Close supervision during every step of processing assures CARBIDE's customers of highest quality chemicals–from the point where natural gas enters its plants to the shipping platforms.

At the gas pumping stations, a continuous check is maintained to make certain that CARBIDE's raw material streams meet strict standards. As they are separated, components are analyzed by mass spectrometer. While being processed, material samples undergo careful chemical analysis. Certain materials in process are further examined with a vapor fractometer, or other appropriate equipment.

Finished materials are subjected to strenuous performance tests, for each of CARBIDE's products must fulfill the expected requirements of customers. Even during loading operations, the final product is rechecked for purity–with an emission spectograph, for example – to make sure it contains no metallic impurities.

And all the while, CARBIDE's Quality Control Laboratories study better testing methods and more advanced scientific devices to assure customers of consistently highest quality.

Tear out this coupon. Check the boxes on which you'd like more information, and mail to Dept. H, Union Carbide Chemicals Company, 30 East 42nd Street, New York 17, N. Y.

☐ Chemicals for Resin Emulsions. ☐ Ethylene Oxide–handling and operating methods. ☐ TERGITOL. ☐ Ethers and Oxides.

Name_____

Company_____

Street_____

City_____ Zone____

State_____

And remember, there is a CARBIDE sales office near you where you can obtain the services of a CARBIDE Technical Representative. His wide industry experience is backed by both extensive chemical training and by Technical Specialists.

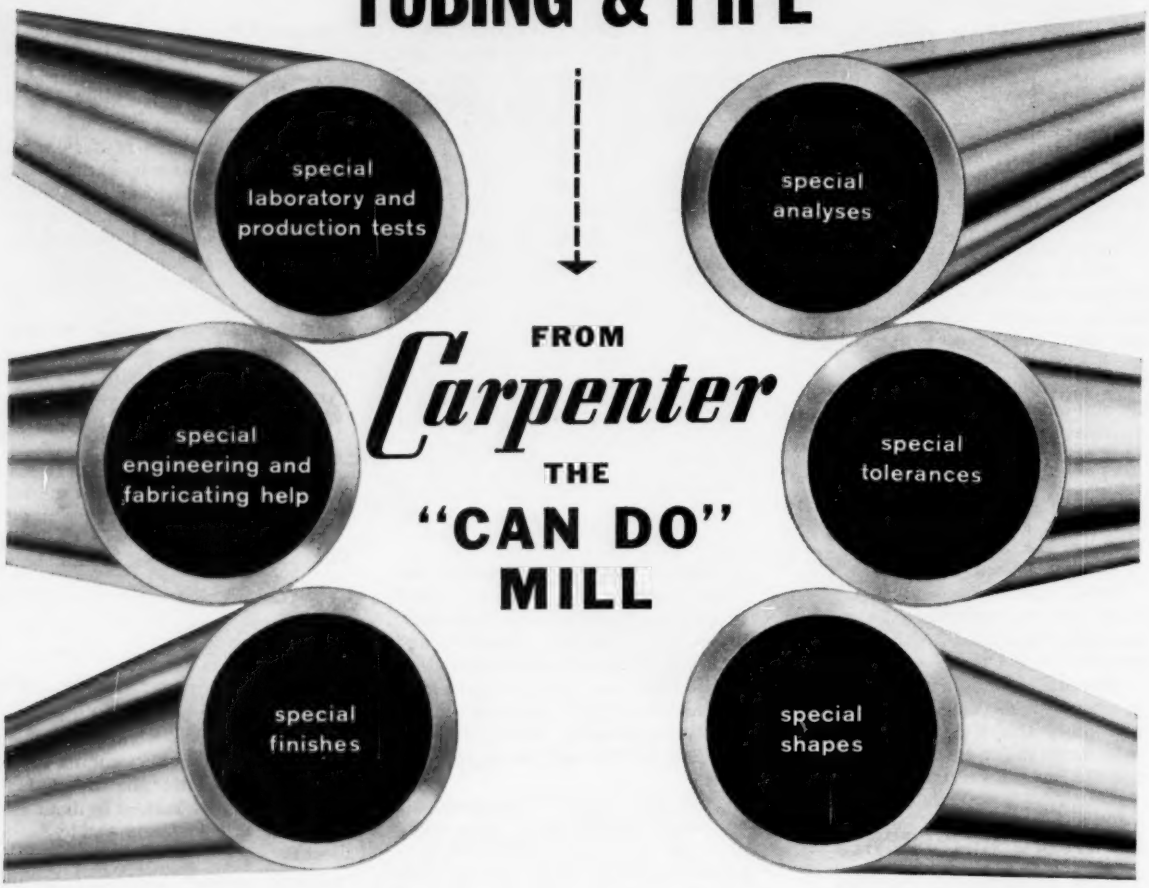
"Cellosize", "Tergitol", and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

UNION CARBIDE CHEMICALS COMPANY

DIVISION OF

UNION CARBIDE CORPORATION

Where to get your "special needs" of Stainless and High Alloy TUBING & PIPE



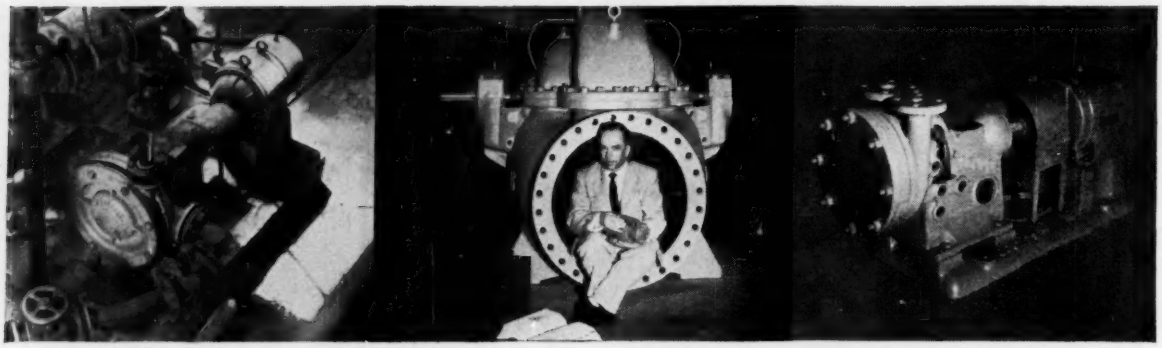
Anytime you come up against *unusual* needs for stainless or high alloy tubing and pipe . . . anytime you are faced with hard-to-solve problems of corrosion, temperature conditions, fabrication, installation and design-engineering . . . it's time for you to consult with Carpenter. Save yourself time, worry and money by putting your "special needs" in our competent and experienced hands. Carpenter facilities and technical staff are geared to give you specialty services not available from other sources. Supplying plant engineers, equipment builders and product designers with the tubing, pipe and "know-how" to satisfy out-of-the-ordinary needs is a 32-year-old story with the Carpenter Alloy Tube Division. Whether your future needs are special or just ordinary, call in your Carpenter representative or contact The Carpenter Steel Company, Alloy Tube Division, Union, N. J.

your master key to cost-saving corrosion control

Stainless & High Alloy Tubing & Pipe

PUMPAGE

Goulds news about pumps for process industries



Idea from a cosmetic bottle

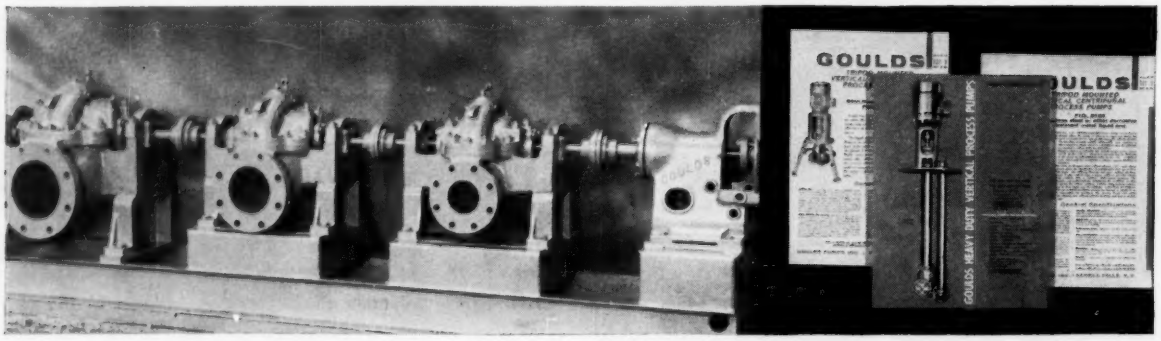
Cold wave lotion made from Evans Chemetics' thioglycolic acid comes to consumers in a bottle. A *glass* bottle. That set Evans to thinking: if *glass* prevents contamination in packaging, why can't it do the same job in *processing*? So they installed a Goulds-Pfaudler *glassed* pump. In it, glass is permanently fused to metal at every surface that contacts the pumpage. Result? Where expensive alloys were required to prevent contamination during processing, now smooth *glass* does the job . . . *better!* Maintenance and replacement problems ended too—for a full year after installation! Write for Bulletin 725.2.

Largest and smallest

The man dwarfed by the giant pump is a Goulds Application Engineer. Look closer. He's holding another pump, small enough and light enough to be held in one hand! His assignment: select the right pump for *your* specific need from all the pumps that fall within the range of Goulds' largest and smallest pumps. For instance—want to move a *lot* of liquid *fast?* That big job does it at *40,000 GPM!* Need a small, stainless steel pump that you can use 24 hours a day for chemical circulating or transfer work? Get as little as 1 GPM with the little pump. Cut pumping costs with the *right* pump for your job.

Pump with a built-in "steam bath"

When fat is a problem—try a steam bath! The steam bath we're speaking of keeps fats, wax, paraffin and other low-melting point solids *fluid* in your pumping system. It's "built-in" on the Goulds Fig. 3715 chemical pump to maintain high process temperatures—right at the pump. A steel steam jacket of full casing diameter keeps *all* the liquid in the pump hot. Can be furnished with new, or added to existing, pumps. You pump low melting point fluids or saturated salt solutions without "freezing"—to reduce down time in your operation. Write for Bulletin 725D17.



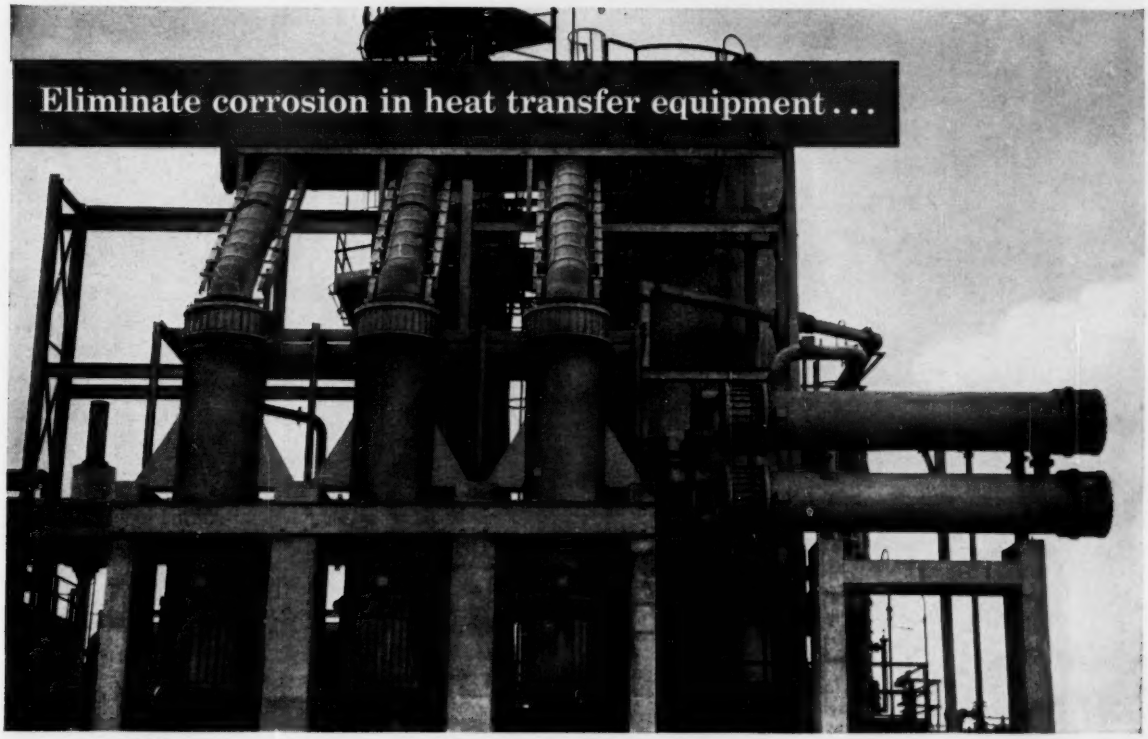
Tandem-mounted pump idea

Here's where it might pay you to put all your eggs in a single basket! One oil refiner set up four Goulds pumps *in tandem*, powered the whole works with one steam turbine. Advantages? The combined total horsepower allowed selection of a more efficient large turbine with reduced steam consumption—plus eliminating 3 turbines, bases and foundations. The two Goulds Fig. 3405 pumps in the center handle rich oil at 300 and 375 GPM respectively, with heads of 211 feet. At the left is a Goulds Fig. 3405 that pumps 600 GPM of lean oil at 248 ft. head. Pump on the right is a Fig. 3755 for supplying still reflux at 155 GPM and a head of 149 feet. All pumps and the turbine are mounted on a common steel base.

News about vertical process pumps!

Here's a complete rundown on what's new with heavy-duty vertical process pumps for handling corrosive liquids in the chemical process and allied industries. In many applications in the process field, the use of vertical pumps for transfer or other services offers many advantages. Advanced design provides for wet pit, dry pit and tripod-mounted pumps with maximum interchangeability of parts. These booklets list them all—and they're yours *free*. Just send to Goulds for your copy. Write Goulds Pumps, Inc., Dept. CE-59, Seneca Falls, New York.

GOULDS GP PUMPS



USE "KARBATE" HEAT EXCHANGERS

Engineered for maximum corrosion resistance and minimum maintenance, these shell and tube heat exchangers are so constructed that all surfaces in contact with corrosive fluids are of "Karbate" impervious graphite. This unique material offers *complete corrosion resistance, high thermal conductivity and immunity to thermal shock.*

Always consider "Karbate" impervious graphite heat exchange equipment where corrosion is a problem. You'll be pleasantly surprised at the low first cost in comparison with heat exchangers having far less effective resistance to corrosion.

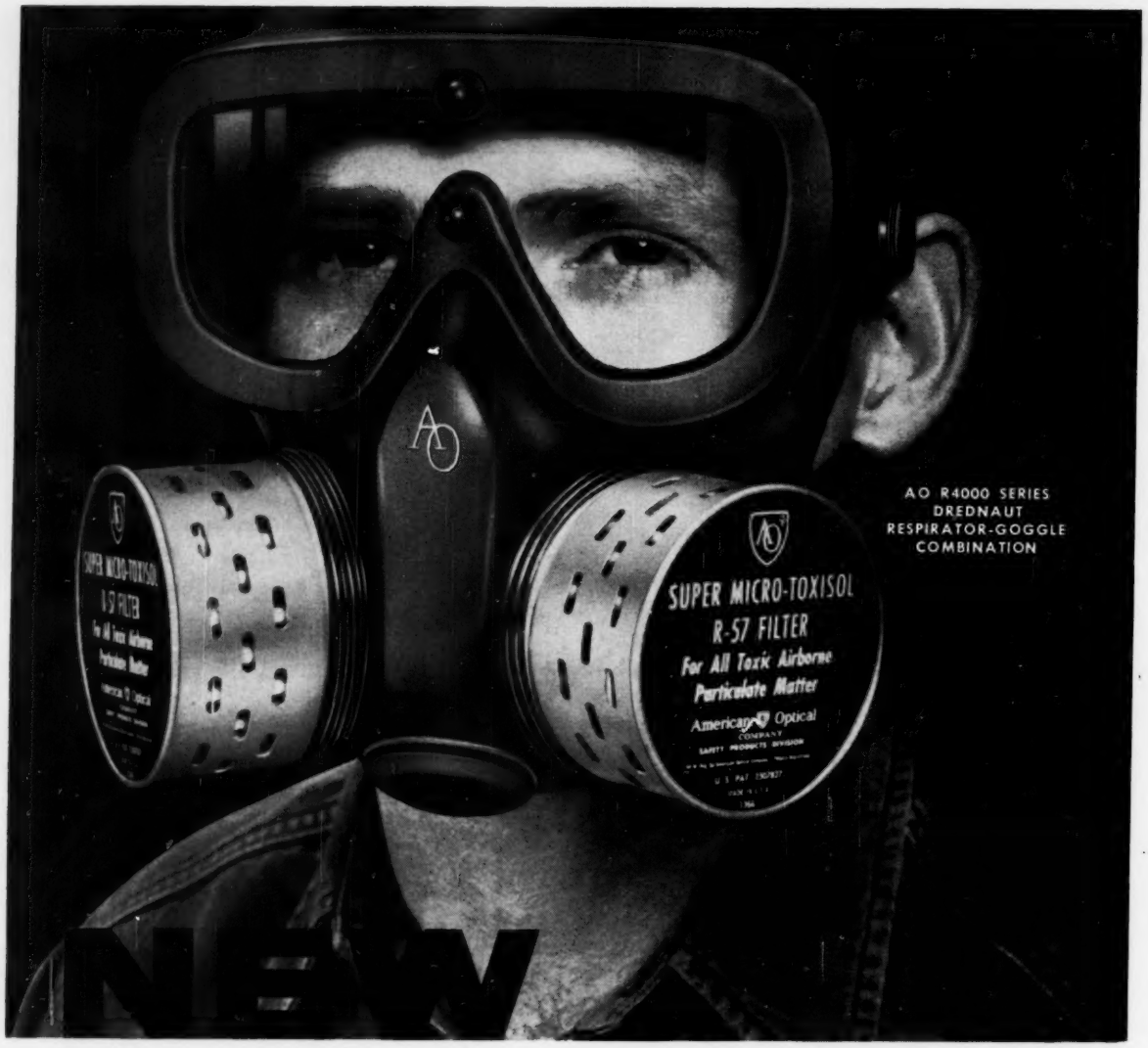
Write for Catalog Section S-6800

Buy "Karbate" shell and tube heat exchangers—any size, any type, any design — directly from National Carbon Company, pioneers and experts in heat transfer with corrosives.

Components of all sizes of "Karbate" heat exchangers are manufactured in quantity and carried in stock. You save money . . . you save time . . . when you specify "Karbate" impervious graphite shell and tube heat exchange units.

Series	Nom. Size Shell	No. of ⅞" I.D. x 1¼" O.D.	HEAT TRANSFER SURFACE OUTSIDE TUBES, SQ. FT.				
			6' Long Tubes	9' Long Tubes	12' Long Tubes	14' Long Tubes	16' Long Tubes
90	6"	9	17.7	26.5	35.4	—	—
190	8"	19	37.3	55.9	74.5	87.0	99.5
310	10"	31	45.6*	91.2	121.6	141.9	162.2
420	14"	42	81.7	123.3	164.8	192	220
640	16"	64	124.3	187.7	251	293	335
850	18"	85	165.2	250	334	389	444
1090	20"	109	213	320	427	499	570
1350	22"	135	263	397	530	618	706
1630	24"	163	317	479	640	746	852
1950	26"	195	379	573	766	892	1017
2330	28"	233	453	684	914	1065	1217
2680	30"	268	521	786	1051	1225	1400
3490	34"	349	679	1024	1368	1595	1822
4390	38"	439	855	1289	1722	2009	2295
5960	42"	596	1162	1749	2336	2727	3118
6850	45"	685	1335	2010	2685	3135	3585

*This unit has 4½' long tubes.



26 RESPIRATORS IN 1!

(Combined with Eye Protection)

Cut costs, simplify inventory with the AO R4000 Drednaut Series — offering the greatest number of respirator and goggle combinations yet against a multitude of hazards! Facepiece and filters provide cost-saving interchangeability and AO high quality.

Facepiece (a mask within a mask) is a single piece of rubber. Inner mask protects respiratory tract; outer mask protects eyes, also. By isolating nasal-oral section, inhaled and exhaled air is excluded from goggle area. Thus: **1.** Warm, moist air cannot reach goggle lens to fog **2.** Carbon dioxide from exhaled air is held to a minimum **3.** Type of construction permits wear of spectacles with flat temples. No positive or negative pressures in goggle section due to breathing.

Heavy duty plastic lens will withstand severe impact and is easily replaceable. Unit is lightweight and very comfortable. Elastic head harness is easy to adjust for comfort and fit. Write for new brochure S-8016. Or ask your nearest AO Safety Products Representative.

Recommended Uses: For exposure to dusts, mists, vapors, fumes and gases singly or in combination in the chemical industry, general industry, agriculture. Also for protection against radioactive particulate.

American Optical
COMPANY
SAFETY PRODUCTS DIVISION
SOUTHBRIDGE, MASSACHUSETTS
Safety Service Centers in Principal Cities

Always insist on AO Trademarked Safety Products

SERIES 60 FILLS ALL NORMAL STEAM TRAP REQUIREMENTS

If condensate loads are average, pressures between 10 and 400 psi, temperatures under 450° F—then Series 60 are the Yarway Impulse Steam Traps for the job.

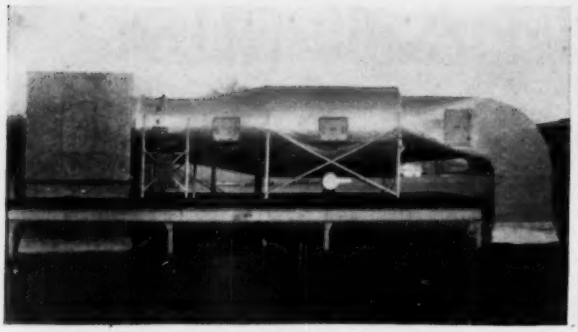
These Yarways give you unequalled advantages of *quick heat-up and steady temperatures due to continuous sampling flow, only one moving part, low maintenance, stainless steel construction, small size and light weight, good for all pressures within range, non-freezing, six sizes to choose*—PLUS *low initial cost.*

Specify Yarways on your steam equipment. Buy them from 270 convenient Industrial Distributors. Over 1,250,000 Yarways already sold.

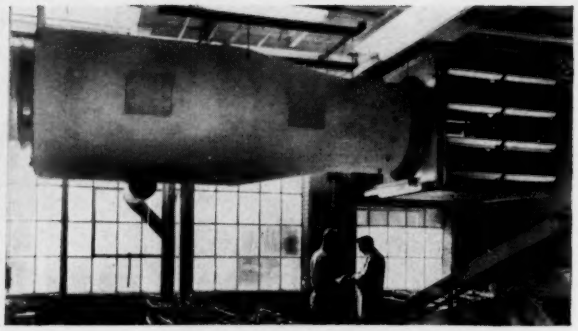
YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.

SERIES 60—normal needs, pressures to 400 psi, 6 sizes. **SERIES 120**—normal needs, pressures to 600 psi, 6 sizes. **SERIES 40**—for extra heavy loads, 5 sizes. **NO. 30**—for extra light loads (½" only). **INTEGRAL STRAINER**—highest pressures and marine use, 6 sizes.

YARWAY | *impulse® steam traps*

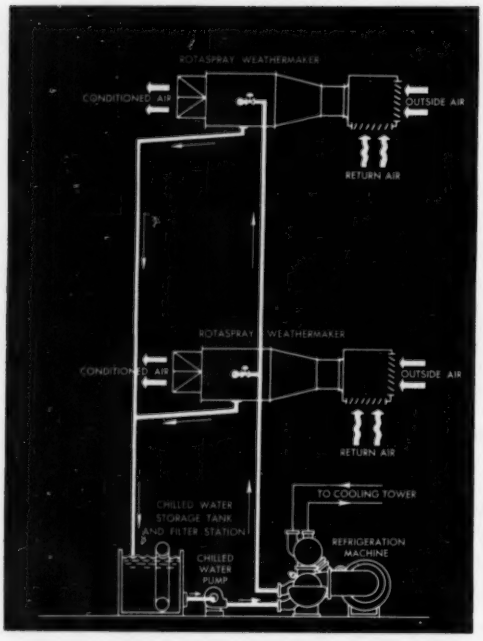


Roof-top Rotaspray installation



Ceiling-mounted installation

Major breakthrough in process air conditioning...



Rotaspray units are self-cleaning, and require no filters. A single refrigeration machine with chilled water storage tank and filter station will handle a multiple unit system with units located at many remote points. Each unit provides individual control of temperature and humidity.

CARRIER ROTASPRAY WEATHERMAKER SYSTEM*

This revolutionary new Carrier air conditioning system is now available to the chemical industry. Its superiority has been proved by four years of field operation on many different installations. Compared with past systems, it provides better control, it lowers construction and maintenance costs —and occupies less space.

Operating at high air velocity (2600 fpm) Rotaspray units are only ⅓ as large as conventional air treating apparatus for the same capacity. Furthermore, they can be located out of doors, with no protective shelter. For system arrangement, note the diagram at left.

Each Rotaspray unit is made of stainless steel for long life. Each provides superior control of temperature and humidity, and offers unequaled ability to meet load variations in the area it serves. Units are compact and light, can be hung from the ceiling, put on the roof or suspended outside on the wall. Four sizes: 10,500 to 30,000 cfm.

For complete information on this new system, call the Carrier office near you. Or write Carrier Corporation, Syracuse, New York.

*Pat. Pending

MORE PROOF OF
BETTER AIR CONDITIONING FOR EVERYBODY EVERYWHERE

Carrier

GNER
ral-Type
earmotors

Wagner Integral-Type Gearmotor with TEFC motor. Standard or explosion-proof.

er Integral-Type Gearmotor
open protected motor.

For the Power you want - At the Speed you need !

Wherever you need "slower than motor speeds" you can get positive speed reduction with plenty of power by using Wagner Gearmotors.

This extension to the Wagner line provides compact motorized drives, with both motor and gear housing of corrosion-resistant cast iron. Available with the latest NEMA Frame open protected or totally enclosed fan-cooled motors, they combine Wagner motor dependability with rugged, simplified gear units to give you speed reduction equipment designed for greater capacity and longer life in ordinary up to rough service.

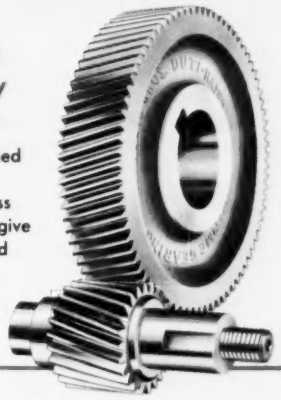
Wagner Gearmotors offer a wide variety of sizes in single, double, triple or quadruple reductions—horizontal or vertical foot or flange mountings—speeds from 7½ to 780 RPM. Write for Bulletin MU-227.

Whether you specify or apply power transmission equipment, your nearby Wagner Sales Engineer will be glad to help you select the right drive for your applications. There are Wagner Branches in 32 principal cities.

Wagner Electric Corporation
6400 PLYMOUTH AVENUE, ST. LOUIS 14, MISSOURI

Heat treated high capacity helical gears

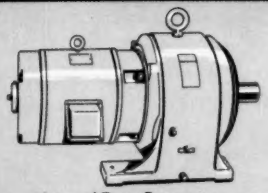
Gears are hardened after cutting, for maximum hardness and accuracy, to give extra capacity and longer wear life.



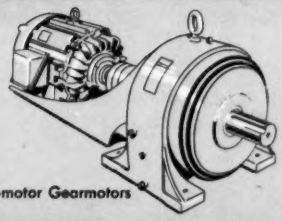
Positive Oil Seals

Improved lip type seals are used on horizontal shafts. On vertical output shafts, double mechanical seal with slinger and drain-off gives positive protection against leakage.

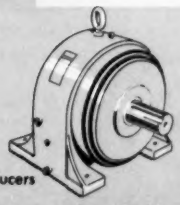
WAGNER SPEED REDUCTION EQUIPMENT



Integral-Type Gearmotors



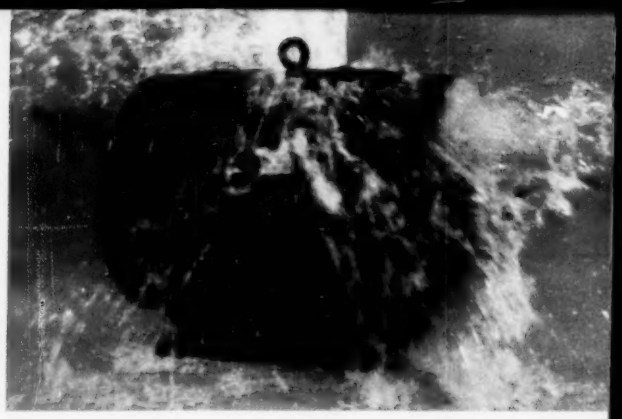
All-motor Gearmotors



Speed Reducers

Shaft-mounted Speed Reducers

DOUBLY PROTECTED. Air intakes and outlets protect against falling or splashing liquids. Cast iron frames protect against rough handling and corrosion.



TYPE DP · Doubly Protected against corrosion · against falling or splashing liquids

These motors give the double protection of corrosion-resistant cast iron frames and dripproof enclosures that are so well designed that they can be used in many applications that formerly required splashproof motors. Available with ball bearings, or with high load carrying capacity sleeve bearings for extra quiet operation. Write for Bulletin MU-223.

1 TO 125 HORSEPOWER – 1750 RPM – 40° C – NEMA FRAMES 182 THROUGH 445U

You get less downtime, lower upkeep, with WAGNER PROTECTED-TYPE MOTORS

If you need motors that will keep production rates up . . . that will give you the continuity of service you want . . . that will operate with complete dependability under the most severe conditions in their specific applications—use Wagner Protected-Type Motors. These motors pack extra power into little space, are light in weight, and are easy to maintain.

Let your Wagner Sales Engineer show you how these protected motors can bring you savings in initial motor costs, maintenance costs, and in continuity of operation.

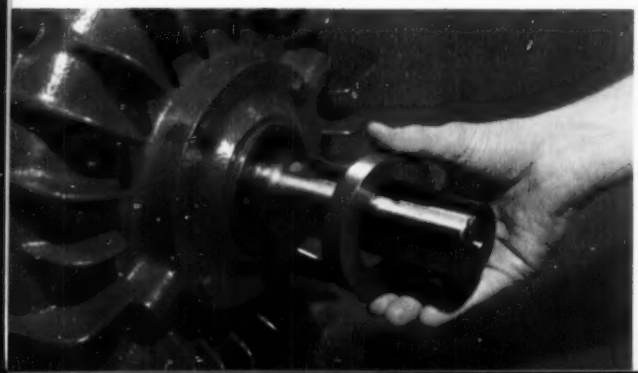
Wagner Electric Corporation
6400 PLYMOUTH AVENUE, ST. LOUIS 14, MO., U. S. A.

WM59-10

1 TO 100 HORSEPOWER – 4 POLE – 60 CYCLE – NEMA FRAMES 182 THROUGH 445U

TYPE EP · Extra Protected against corrosive or abrasive elements

Wagner Type EP Motors are totally-enclosed, fan-cooled—for complete protection against dust, abrasives, fumes, steel chips or filings. Type JP is explosion proof as well—designed and approved for use in explosive atmospheres. Cast iron frames protect against corrosion and ribs on the frames add mechanical strength and increase the surface cooling area. Effective cooling system adds to motor life. Write for Bulletin MU-224.



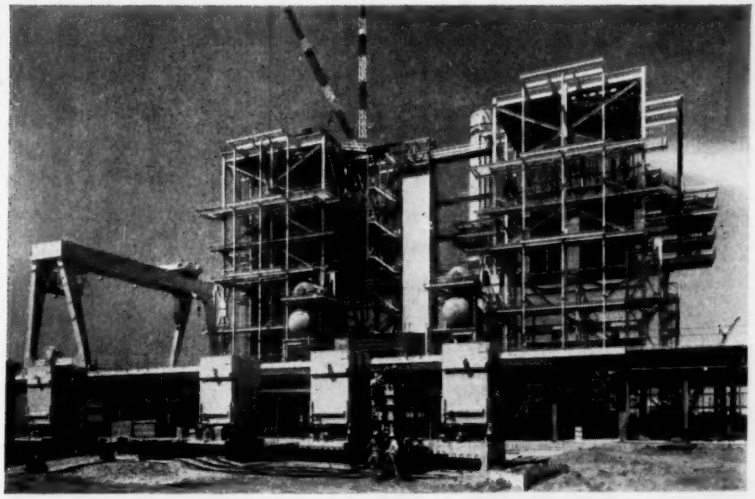
SECURELY SEALED FOR LOW MAINTENANCE. Both ends of these motors have running shaft seals to keep the heavy duty bearings clean. Bearing housings are effectively sealed to prevent escape of grease. Openings are provided to permit relubrication that adds years to motor life under severe conditions.

FRESH WATER NEWS

from Cleaver-Brooks Special Products, Inc.

CAPSULE REPORTS AND INFORMATION ON THE PRODUCTION OF FRESH WATER FROM THE SEA

Pilot plant in California may open new era in salt-to-fresh water conversion



In a contract recently awarded to Cleaver-Brooks Special Products, Inc., the Southern California Edison Company embarked on a far-reaching program for conversion of sea water to fresh water. The contract calls for construction of a sea water distillation plant with a capacity of about 100,000 gallons a day. It will be operated in conjunction with existing steam generating facilities at the Mandalay Steam Station near Oxnard, Calif. The operation will be the first of its kind in the country.

In awarding the contract, Southern California Edison revealed that Cleaver-Brooks Special Products had made its bid on an evaporator based on a new principle which greatly reduces required heat transfer surface and pumping power. The new unit can be used for both distillation through use of residual heat in cooling water and for distillation using steam extracted from the turbine.

Success of the pilot plant will signal a significant step forward toward the tapping of ocean water for use in home, industry and agriculture. However, Edison officials caution that at this time the water produced by the pilot plant is not expected to compete in cost with fresh water from natural present sources. The hope is that similar installations will eventually be advantageous to use in areas where current water costs are high.

Upon completion of construction, Cleaver-Brooks engineers, who worked with Edison in designing the job, will continue to cooperate in its operation.

NEW CONSTANT CAPACITY EVAPORATOR CAPTURES WASTE DIESEL HEAT TO SUPPLY FRESH WATER FOR OFF-SHORE RIGS

A new high-capacity waste heat evaporator for off-shore drilling rigs and tenders has been developed by Cleaver-Brooks Special Products, Inc.

Operating from waste heat of generator-driving diesels, the new flash type unit manufactures fresh water from sea water at constant output. And output is independent of drilling operations.

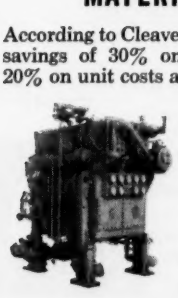
Costs are kept low due to conservation of fuel and unusually low maintenance requirements.

The heat required for evaporation is derived from the diesel engine cooling water. The flashing principle utilized by the new unit eliminates scaling problems common with conventional evaporators. Maintenance usually involves only simple brush-out after prolonged periods of operation.

As installed, the unit can provide pure water for drinking, drilling, make-up, bathing and cooking.

ENGINEERS EXPLAIN HOW NEW METHODS, MATERIALS CUT COSTS, REDUCE UNIT SIZE

According to Cleaver-Brooks engineers, savings of 30% on unit volume and 20% on unit costs are possible through new design and construction of the company's evaporation and distillation equipment.



For example, the deck space needed for a 12,000 gpd flash evaporator has been reduced from 70 sq. ft. to 55 sq. ft., height cut by 12%.

On the cost side, improved design using equally reliable but lower-cost materials and improved manufacturing techniques — resulted in cost cuts of 20% on one model.

Today, Cleaver-Brooks flash evaporators get one-eighth grain of sea salts per gallon of sea water rather than the usual residue of one-fourth grain per gallon — a 50% improvement in effectiveness.

Tune up furnaces with dashboard simplicity Using a Bailey HEAT PROVER Analyzer

• For fast accurate combustion analysis, compare this portable unit to Orsat measurements: It tells you **what's happening** as you make furnace, kiln, or engine adjustments, **not what happened!** No guessing, no spot readings to average. Simple, convenient to use.

The continuous readings from a Bailey HEAT PROVER Analyzer enable operators to correct combustion variables before costly losses are incurred. The two meters on the analyzer show per cent by volume of oxygen and combustibles on either a 20% range span or a more sensitive 4% range. Temperature of the gases in degrees Fahrenheit may also be shown.

To order or get additional facts, write us direct or contact any of our District Offices. You'll find them listed in Chemical Engineering Catalog, Refinery Catalog, Thomas Register, or Mechanical Catalog.

Gas analysis with Bailey **HEAT PROVER** Analyzer at a process heater. Per cent oxygen and combustibles is shown continuously while testing.

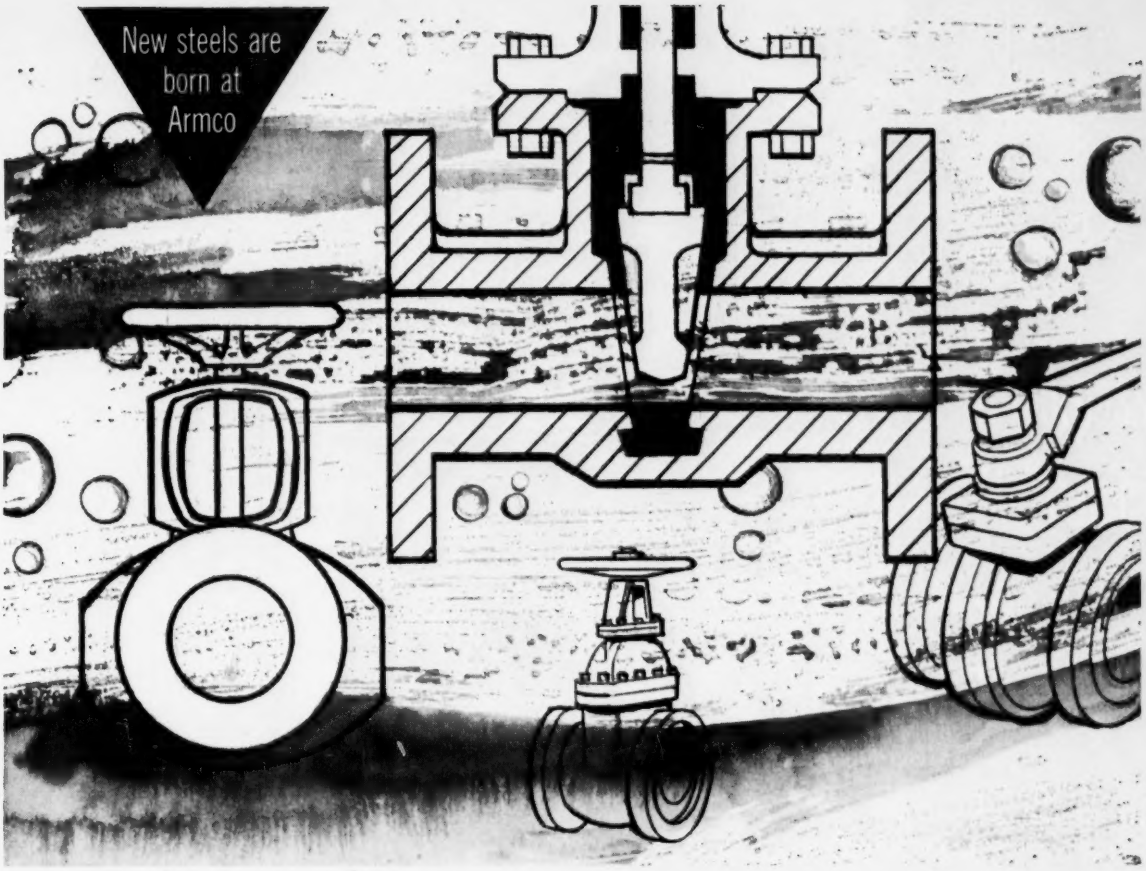
CP106-1

Chemical and petroleum division

BAILEY METER COMPANY

1054 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal



HOW ARMCO 17-4 PH STAINLESS STEEL SOLVES TROUBLESOME VALVE PROBLEMS

Provides combination of properties that minimize galling, abrasive wear, erosion and corrosion at low cost

Armco 17-4 PH Stainless Steel eliminates troublesome and costly valve maintenance because it has high hardness and strength to 900F, plus good corrosion resistance. It combines the mechanical properties of the hardenable stainless steels with corrosion resistance comparable to 18-8.

Mechanical Properties (Typical)

Ultimate tensile strength	200,000 psi
Tensile yield strength	185,000 psi
Endurance limit, 10^7 cycles	90,000 psi
Hardness, Rockwell	C-44

Corrosion Resistance — Superior to all the standard hardenable stainless grades. Laboratory and service experience demonstrate durability similar to Type 304. Good resistance to erosion-corrosion. (Observation on Corrosion Resistance of High Strength Stainless Steels, John Halbig and O. B. Ellis, Corrosion, August, 1958.)

Fabricating Properties — Armco 17-4 PH, available in bars and billets, can be readily machined, welded, forged and cast. Single low temperature heat treatment is simple.

This special precipitation-hardening Armco Stainless Steel is used in many kinds of valves for stems, guide bushings, plugs, balls, wedges, discs, bolts and trim. For the valves *you* make or use, take advantage of the economy and better performance possible with Armco 17-4 PH Stainless Steel. For more data and a copy of the new booklet, "How Armco Stainless Steels Serve the Petrochemical Industry," call your Armco Stainless Steel Distributor or mail us the coupon.

ARMCO STEEL CORPORATION, 2029 Curtis Street, Middletown, Ohio

Send me ☐ your new booklet, "How Armco Stainless Steels Serve the Petrochemical Industry"

☐ More information on Armco 17-4 PH Stainless Steel for these applications

NAME_____

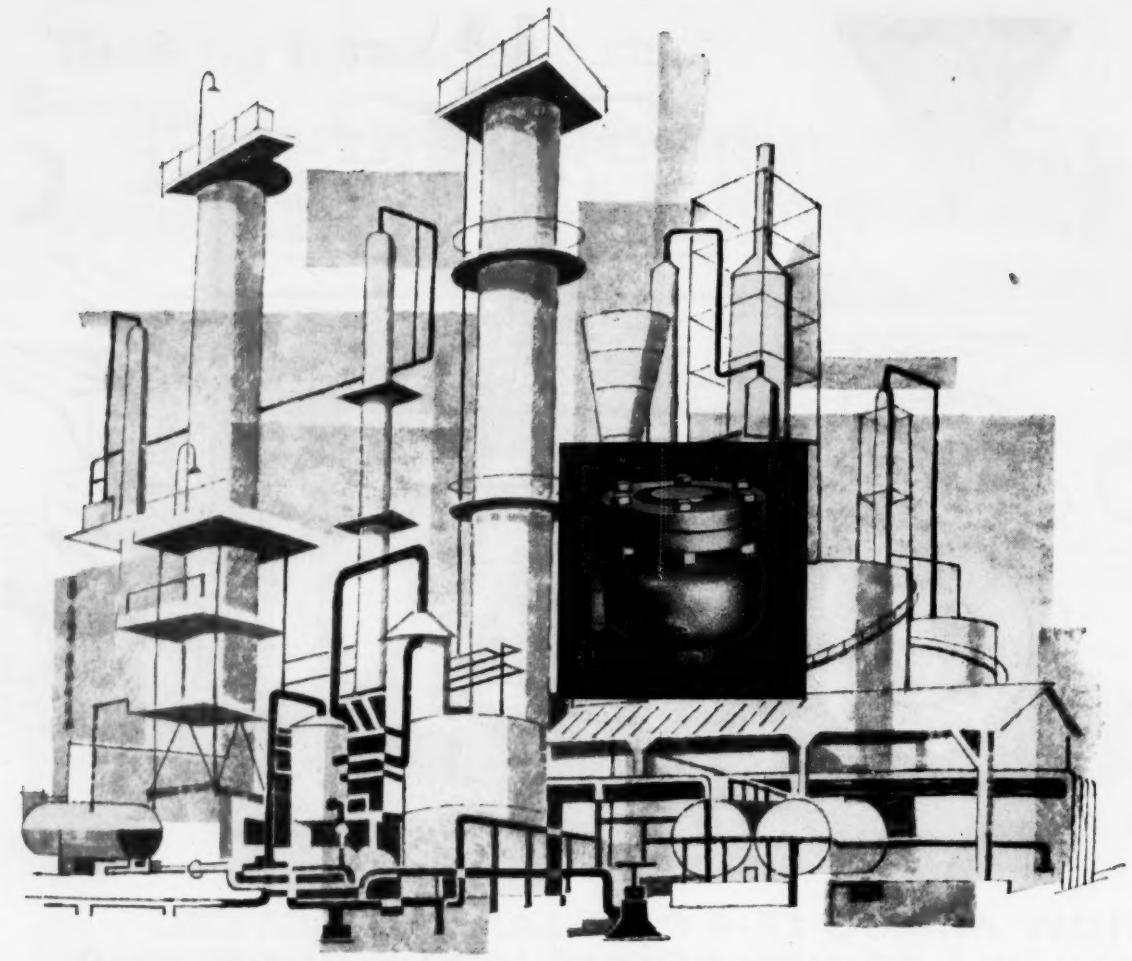
COMPANY_____

STREET_____

CITY_____ ZONE____ STATE_____

ARMCO STEEL

Armco Division • Sheffield Division • The National Supply Company • Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Union Wire Rope Corporation • Southwest Steel Products



THE ECONOMICS OF STEAM TRAP SELECTION

Initial cost versus installed cost

Everybody wants to save money in the purchase of steam traps, or anything else.

But a wise buyer will recognize that the *real cost* relates to the entire useful life of his plant, and that selection of the most efficient trap for a given application is an important consideration.

Compare the efficiency of Nicholson traps with that of so-called "bargains" and you'll see why plant engineers responsible for successful operation usually insist on Nicholson.

ST-102

NICHOLSON

OF WILKES-BARRE

W. H. Nicholson and Co. • 16 Oregon Street • Wilkes-Barre, Pa.

Distributors in all principal cities

Unsurpassed Mechanical and Electrical Life

NEW complete line of low voltage motor control

Attractive enclosures of this new line of Size 0 through 4 Allis-Chalmers control *forecast* quality . . . modern engineering design *assures* it . . . performance tests *confirm* it. Millions of "life-test" operations attest to the functional quality in every detail — assure the ultimate in dependable performance and sure protection for personnel, motors and machines.

Contact block of glass-filled thermal-setting molding. Contacts of cadmium silver oxide, contact carrier of metal-reinforced molding, dual-voltage coils encapsulated in epoxy-resin — these are just a few of the superior materials used to assure maximum operating dependability and long life.

Accessibility — Modern design provides wide-open accessibility for fast and easy installation, modification, inspection and maintenance.

Flexibility — Flexible design permits making many modifications in the field with ease. Minimum parts requirements facilitate delivery from local stock.

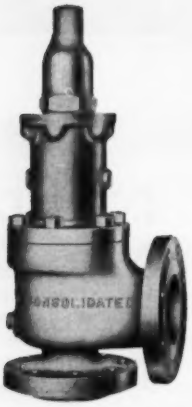
A complete line of low voltage control (Size 0 through 8) and high voltage control *in all NEMA enclosures,* plus engineered control systems. Your A-C distributor or representative will give you all the details. *Or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.*

ALLIS-CHALMERS

A-5986

CORRUGATED SLEEVE

shields working parts



Consolidated Safety Relief Valve with Sealing Bellows. Type 1900-30 Series, Sizes: 1½" x 2" to 8" x 10".

A durable, two-ply stainless steel Sealing Bellows in Consolidated Safety Relief Valves isolates contaminants, corrosion or viscous fluids from the working parts. The Bellows is balanced with the seating surface. Capacity is less affected by variable back pressure, so you can use smaller discharge piping and reduce the cost of pressure-relieving systems.

Full-rated relieving capacity is certain at all positions of the single blowdown adjusting ring because a fixed maximum secondary orifice provides full lift at 10% overpressure. Even with superimposed back pressure in the relieving system, valve action is consistently positive.

Protection of working parts is but one of many reasons why Bellows Type Consolidated Safety Relief Valves assure absolute protection for personnel and facilities. Write for details, including facts about the Standard valve that you can convert to the Bellows type in your own shop. Ask for Catalog 1900.

MAXWELL MANNING M&M & MOORE INC. TRADE MARK

CONSOLIDATED SAFETY RELIEF VALVES

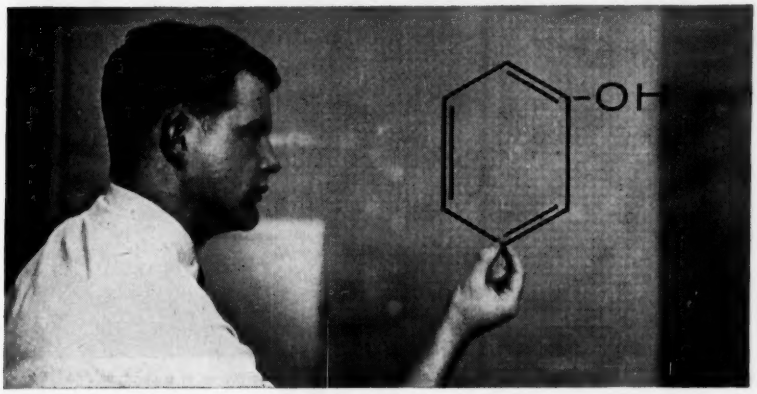
A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Tulsa, Oklahoma
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

BRIEFS

on a top quality phenol...a highly reactive, promising cyclopentadiene ...the many ways to buy Oldbury® phosphorus pentasulfide



99.8% phenol at no extra cost

Now you can order shipments in large quantities of Hooker phenol that assays typically at 99.8% purity by bromination.

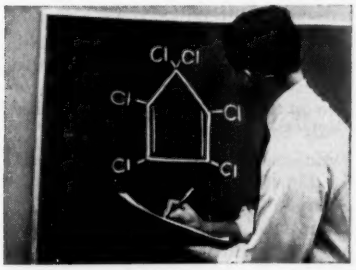
Another indicator of quality is this product's freezing point—a minimum 40.6°C.

Its distillation range is only 2° from first point (180°C) to dryness.

Hooker phenol meets or exceeds all requirements of U. S. Pharmacopoeia XV.

For more complete specifications and other data, send the coupon.

Bulletin on handling phenol. The Manufacturing Chemists Association has put out a Chemical Safety Data Sheet on phenol which we are offering as Hooker Bulletin 166. You can get a copy of this also by sending the coupon.



You might find a new product in this cyclopentadiene group

Take a look at those six active chlorines and the two double bonds.

They are an open invitation to the study of such derivatives as the acids, acid chlorides, acid anhydrides, esters, amides, ketones, *di*-ketones, quinones, acetals, nitriles, and fluorocarbons.

Many of these end products have already found markets as insecticides, germicides, fungicides, pharmaceuticals, dyes, and non-flammable resins.

We think the story on C-56® (hexachlorocyclopentadiene) is just beginning—that the creative chemist will use this versatile chlorocarbon to develop many more profitable products.

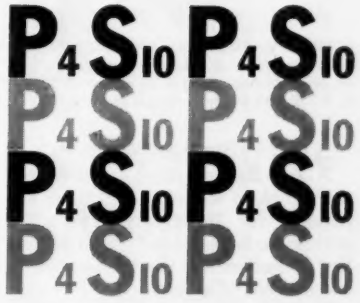
If you can see something in C-56 for your research, send the coupon for more technical information. If you'd like a sample, too, write for it on your business letterhead.

Many ways to buy phosphorus pentasulfide

Could one of the many forms of Oldbury® brand phosphorus pentasulfides help improve your product?

Are you color conscious about your product, for example? We make a special distilled grade (it sells at no extra cost) which is freer than standard P_4S_{10} of the carbonaceous materials which can discolor a product.

Do you want a finer or a coarser powder? We offer three mesh sizes of both standard and distilled grades as well as solid in standard grade. The mesh sizes are 20, 6 and 2. For descriptive technical data sheets, check the coupon below.



If you're worried about ample supply at any time, mark the fact that we have two producing plants—one at Niagara Falls, N. Y. and one at Columbus, Mississippi.

We also make phosphorus heptasulfide and phosphorus sesquisulfide.

Complete data on all three are offered in the coupon.

For more information, check here and mail with your name, title, company and address.

- ☐ Handling Phenol, Bulletin 166
- ☐ Phenol Data Sheet No. 811
- ☐ Hexachlorocyclopentadiene, Data Sheet No. 815
- ☐ Phosphorus Pentasulfide, Data Sheet No. 801
- ☐ Phosphorus Heptasulfide, Data Sheet No. 798
- ☐ Phosphorus Sesquisulfide, Data Sheet No. 803

HOOKER CHEMICAL CORPORATION
405 FORTY-SEVENTH STREET, NIAGARA FALLS, N. Y.

Sales Offices: Chicago Detroit Los Angeles New York Niagara Falls Philadelphia Tacoma Worcester, Mass.
In Canada: Hooker Chemicals Limited, North Vancouver, B. C.

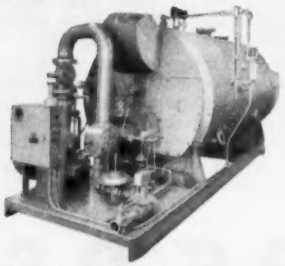
HOOKER CHEMICALS PLASTICS

Eclipse vaporizers for Dowtherm cut high-temperature process heating costs

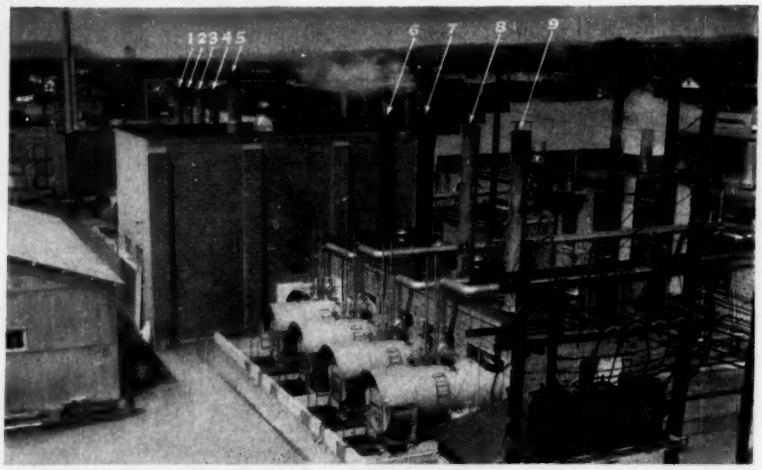
. . . nine units provide flexible, accurate, high-temperature control and safe, low pressures at Eastern plant

How to get an exact amount of heat to a particular place at low cost in order to maintain product uniformity is a big problem faced by high-temperature process heat users.

Direct fire under the cooking or heating vessel is hard to control and seldom safe. Steam requires high pressures for high temperatures. This presents safety and control problems, and requires costly extra-heavy equipment.



ECLIPSE VAPORIZERS FOR DOWTHERM. Available in vertical or horizontal models for gas, oil, or combination firing in 33 sizes from 30,000 to 6,000,000 Btu/hr — temperatures to 700° F.



NINE ECLIPSE VAPORIZERS for Dowtherm maintain cooking oil temperatures at a constant 375° F at a large Eastern food products plant. The accurate temperature control made possible by using Dowtherm takes the headaches out of maintaining product uniformity. The multiple-unit setup provides great flexibility for varying load or temperature demands. Also downtime on a single unit does not seriously affect production. Vaporizers are installed outdoors, eliminating the cost of a special building.

The Answer

A large Eastern plant has answered the problem with nine Eclipse vaporizers for Dowtherm. The units are similar to packaged steam boilers. But Dowtherm is the heating medium instead of steam.

Dowtherm is extremely stable in the 350° F to 700° F temperature range, permitting highly accurate heat control. Even at 700° F, Dowtherm exerts only 95 lb per square inch. This means heavy equipment, piping, valves, etc., are not required — bringing welcome savings on original equipment, operation, maintenance, and replacement.

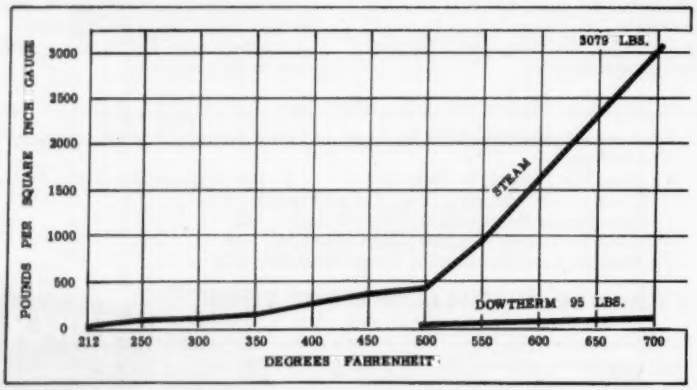
Because of the high rate of heat transfer, it is possible to have relatively low temperature differential between the heat transfer medium (Dowtherm) and the product. This means more efficient operation, less maintenance, and fuel savings.

Eclipse exclusive design features

The large, enclosed furnace of Eclipse horizontal vaporizers for Dowtherm permits high heat output without strain. Burning gases flow turbulently through immersed fire tubes to the stack. Turbulent flow, plus small, specially designed fire tubes, increases heat transfer rate and minimizes flue loss. Vigorous natural circulation around the tubes guards against Dowtherm breakdown, eliminates carbon deposits on vital heat exchange surfaces, and reduces maintenance costs.

All units, vertical or horizontal, are compact, self-contained, automatic heating plants. These units arrive on the job assembled and tested, ready to go to work.

Eclipse has pioneered vaporizers for Dowtherm since the early days of this unique heating medium. The experience thus gained assures you a highly efficient and economical system. For complete details, write, outlining your requirements.



DOWTHERM VS STEAM—at 700° F, Dowtherm system pressure is only 95 psig. At this temperature saturated steam would exceed 3000 psig.

ASK FOR CATALOG A-100

Eclipse®

Eclipse Fuel Engineering Company
1121 Buchanan Street, Rockford, Illinois
EXPORT: Ad Auriema, Inc.
85 Broad Street, New York 4, N. Y.

ONE OF A SERIES

Printed by offset lithography on 80-lb. paper containing Wyandotte PURECAL® in the coating.

Can Wyandotte technical service solve all of your problems?

Not at all!

But our technical service will see to it that each Wyandotte product you buy will deliver the characteristics and performance you want and have the right to expect.

It will give you practical technical assistance to help you fit our products to your needs with the best results.

It will provide you with a ready source for data on chemical and physical properties and specifications of our many products.

It will supply you with a pipeline for new ideas by keeping you posted on new applications of our products . . . new product developments . . . new information gained from our experience in many diverse fields.

It will serve as a sounding board for your own research . . . make available consultations with our science-specialists* . . . eliminate needless duplication of effort . . . save you research and laboratory time.

Why? Because this *is* our deep-rooted and sincere philosophy of doing business. And it is reflected in our technical service, as it is in all our contacts with our customers.

So, if you want extraordinary technical service (and a reliable source of supply for chemical raw materials), send us as much background data as you can, together with the product characteristics you want. We'll go to work for you.

For a pictorial presentation of Wyandotte technical service at work, please turn page.

*Chemists, Chemical Engineers, Physicists, etc., whose industrial or research experience qualifies them as specialists in their particular field.

WYANDOTTE CHEMICALS

SODA ASH • CAUSTIC SODA • BICARBONATE OF SODA • CALCIUM CARBONATE • CALCIUM CHLORIDE • CHLORINE • MURIATIC ACID • HYDROGEN • DRY ICE • GLYCOLS
SYNTHETIC DETERGENTS (anionic and nonionic) • SODIUM CMC • ETHYLENE OXIDE • ETHYLENE DICHLORIDE • POLYETHYLENE GLYCOL • PROPYLENE OXIDE
PROPYLENE DICHLORIDE • POLYPROPYLENE GLYCOL • DICHLORODIMETHYLHYDANTOIN • CHLORINATED SOLVENTS • OTHER ORGANIC AND INORGANIC CHEMICALS

Figuring the economics of Anhydrous vs. 50% Liquid Caustic

. . . an example of Wyandotte technical service at work

1 Anhydrous or liquid? Large users of caustic must make this important decision, which often involves thousands of dollars. The wise user above has invited a Wyandotte technical-service man to visit his plant and make an analysis of his situation.

2 His exhaustive report indicates a switch from anhydrous to 50% liquid, so Wyandotte's engineering facilities swing into action. Equipment is recommended for handling and storage . . . equipment individually tailored to satisfy this user's requirements.

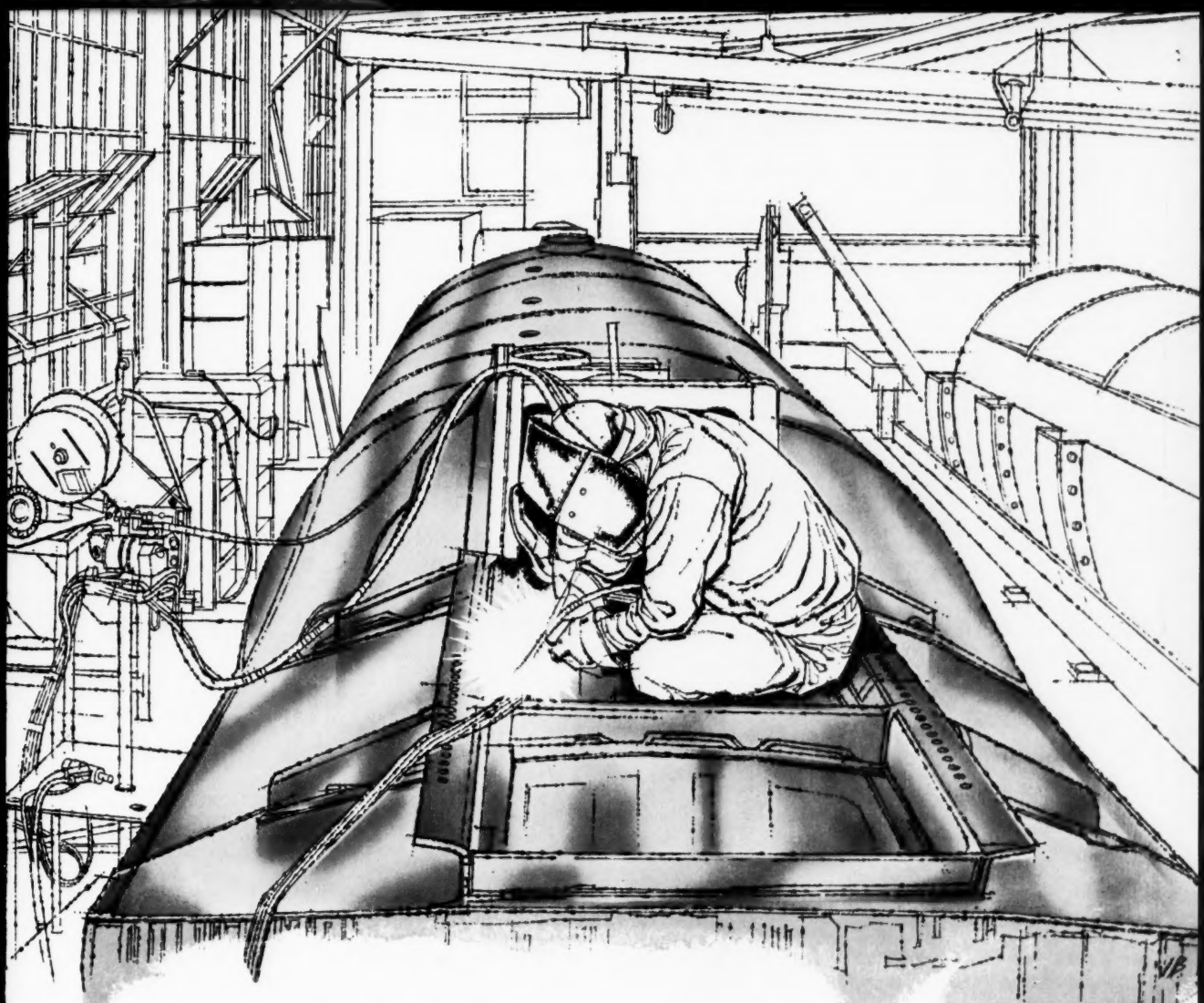
3 This blueprint shows type, size, and location of all equipment the user needs to change over. It is part of a complete report covering all details of construction and operation. Additional consultation is available during the period of construction.

4 This caustic tank car contains a special lining developed and applied by Wyandotte to insure maximum purity of product upon arrival. When the first car arrives at the customer's plant, the technical-service man will be there to facilitate unloading.

Wyandotte
CHEMICALS

Pacing progress with creative chemistry

We believe that technical service should cover all bases. Here is an example of how thorough it can be. And help like this is as near as your phone. If you have a problem that falls within our technological or manufacturing background, check with us . . . our approach is designed to provide answers. *Wyandotte Chemicals Corporation, Michigan Alkali Division, Wyandotte, Michigan. Offices in principal cities.* 723



Formula for Success

The formulation of a stainless steel alloy requires as much precision as any chemical compound. All the care exercised in the selection of a particular alloy can be nullified by variations in the analysis specified.

During fabrication, for example, slight differences in chromium-nickel: carbon ratios can cause changes in microstructure which lead to early failure.

That's why it is safer to specify J&L Consistent Quality Stainless Steel. J&L leads the industry in melt shop standards for stainless steel—the point where quality starts, **and longer service life begins.**

Plants and Service Centers:
Los Angeles • Kenilworth (N. J.) • Youngstown • Louisville (Ohio) • Indianapolis • Detroit

STAINLESS
SHEET • STRIP • BAR • WIRE

Jones & Laughlin Steel Corporation • STAINLESS and STRIP DIVISION • Box 4606, Detroit 34

PRACTICE . . .

PROCESS FLOWSHEET C. S. CRONAN

Capryl Pyrophosphate Ester Extracts Uranium From Wet-Process Phosphoric Acid

Fertilizer producer employs custom-developed process and unique solvent to recover byproduct uranium.

RECOVERING the minute (0.01-0.02%) uranium content from impurity-laden wet-process phosphoric acid requires special processing techniques. U. S. Phosphoric Products, Div. of Tennessee Corp., Tampa, Fla., now employs its own solvent-extraction process to produce a substantial tonnage of uranium tetrafluoride byproduct.

U.S. Phosphoric's process overcomes the impurities in the acid which stabilize emulsions. And the processing techniques minimize loss and avoid contamination of the valuable phosphoric acid product.

Key to the process is the capryl-pyrophosphate ester solvent with its high affinity for uranium. But the ester is unstable and extremely sensitive to operating conditions. So, U.S. Phosphoric precools its acid from 140-175 F. to 80-90 F. before extraction, because the ester decomposes faster than it can extract uranium at temperatures over 140 F.

▶**Readying Acid for Extraction** — Intermediate wet-process acid (25-30% P_2O_5) from its phosphate-rock acidulation plant first flows to a 23,000-gal. tank farm for intermediate storage. Tanks supply an uninterrupted acid flow to a two-stage vacuum cooler, which cools the acid from 140-175 to 80-90 F.

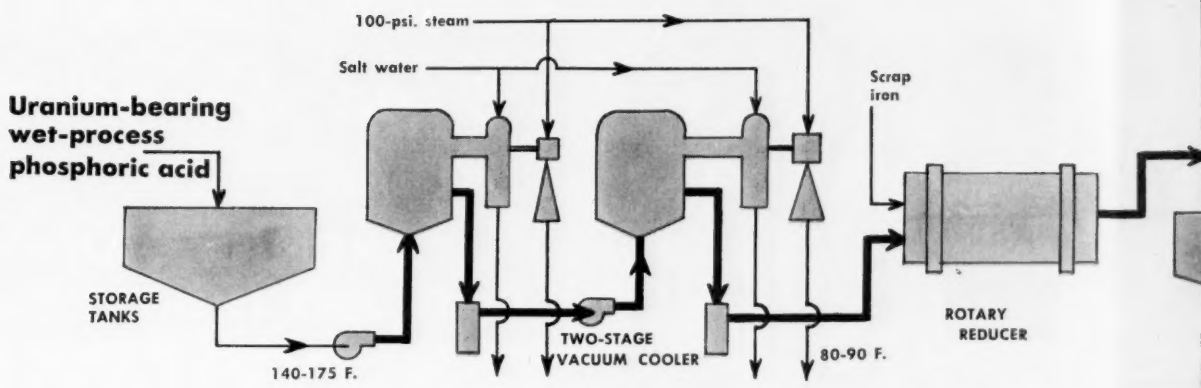
Cooled acid flows through a 7-ft.-dia. 16-ft.-long, ceramic-lined, rotary reducer, shaped like a tube mill. Here, scrap iron reduces the oxidation state of impurities in the acid, thus improves the relative extractability of the uranium. Reduced acid flows to storage tanks where solid impurities such as calcium sulfate and sodium fluosilicate settle.

▶**Solvent Extraction Step**—Clarified acid flows to the four-stage countercurrent-flow, extraction cascade. Here, 3-6% solution of capryl pyrophosphate in kerosene extracts uranium from the acid.

Turbine-agitated mixing tanks intimately contact solvent and acid. Residence time in all mixing stages is 2 min., except for first stage where it is 10 min. For each stage, three disk-bowl centrifuges arranged in parallel, separate the aqueous and organic phases.

Because capryl pyrophosphate decomposes in use, make-up solvent must be continuously produced. This is done by reacting phosphoric anhydride with capryl alcohol in a water-cooled,

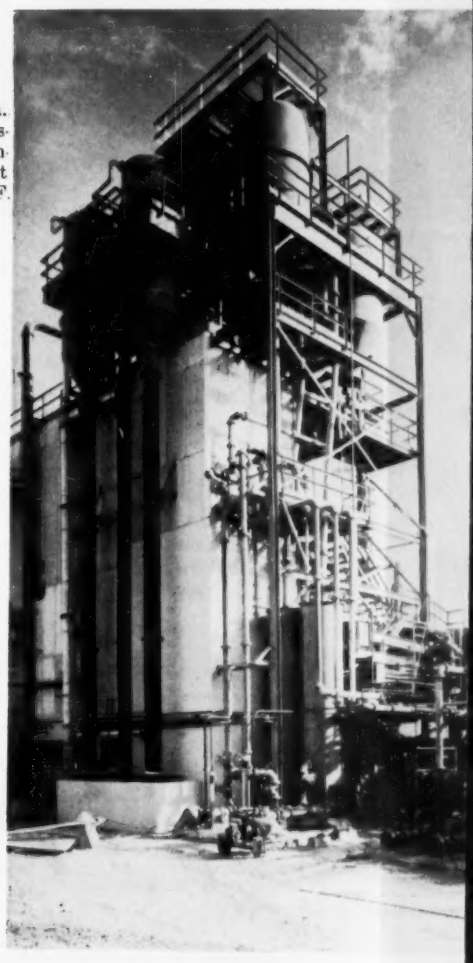
Unfold Flowsheet



Cooling and reduction readies acid for solvent extraction.

Two-stage Vacuum Cooler

Each stage, an 8-ft.-dia. 10-ft.-high, stainless vessel is equipped with a condenser and booster jet helps cool acid to 80-90 F.



agitated, stainless-steel reactor. Make-up ester fortifies recycle ester-kerosene solvent from the precipitation and separation steps to follow.

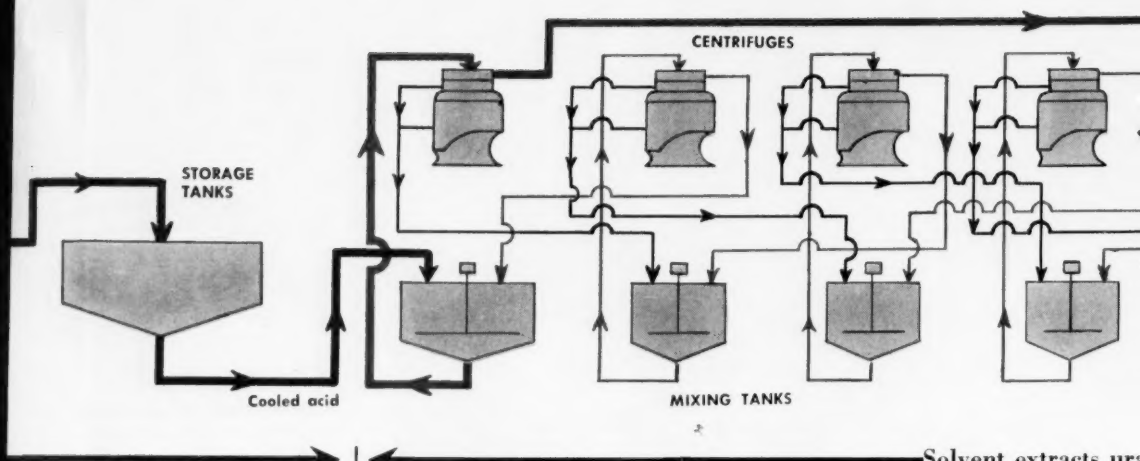
Final-extraction-stage raffinate is uranium-free acid. It flows to a pair of 23,000-gal. settling tanks where entrained solvent is recovered. Uranium-free acid returns to the fertilizer plant for further processing.

Uranium-rich solvent from the first extraction step flows to a single-stage clarifying centrifuge, where uranium-free solids separate from solvent containing about 0.2% dissolved uranium.

▶**Precipitating Green Salt** — Clarified, pregnant solvent flows to a pair of mixing tanks, arranged in series where HF solution precipitates green salt directly from the solvent. Flow rate and tank size keep residence time below 12 min., thus minimizing HF degradation of solvent.

Slurry of green salt, solvent and HF flows to a 48-in. solid-bowl batch centrifuge. Acid recycles to precipitation tanks, and lean solvent to the final extraction stage.

Green salt is periodically discharged from the centrifuge and dried in an oil-fired tray dryer. It is finally crushed, sampled under AEC supervision, analyzed and drummed for shipment.

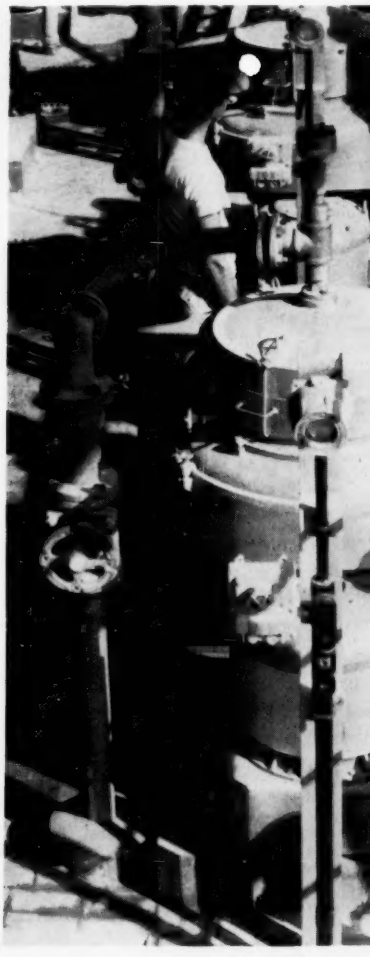


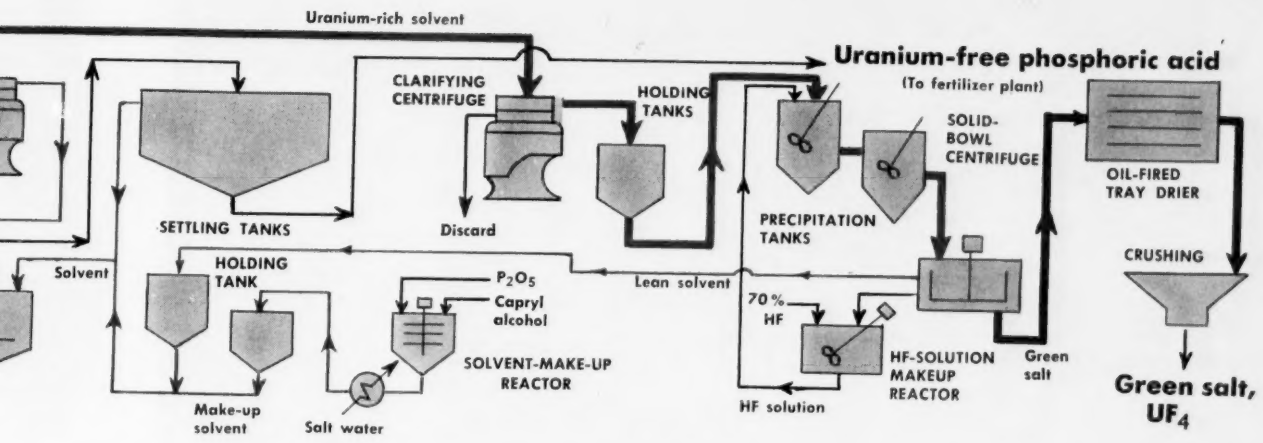
Rotary Reducer

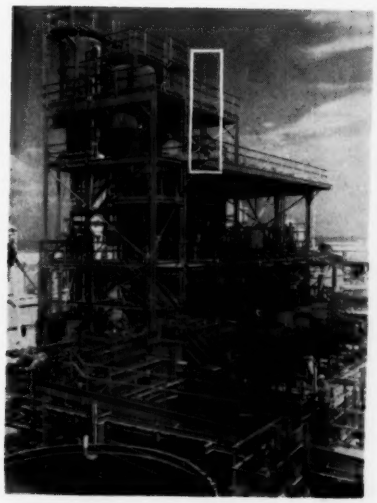
Reduced oxidation state of the impurities in acid, promotes uranium extraction in the next process step.

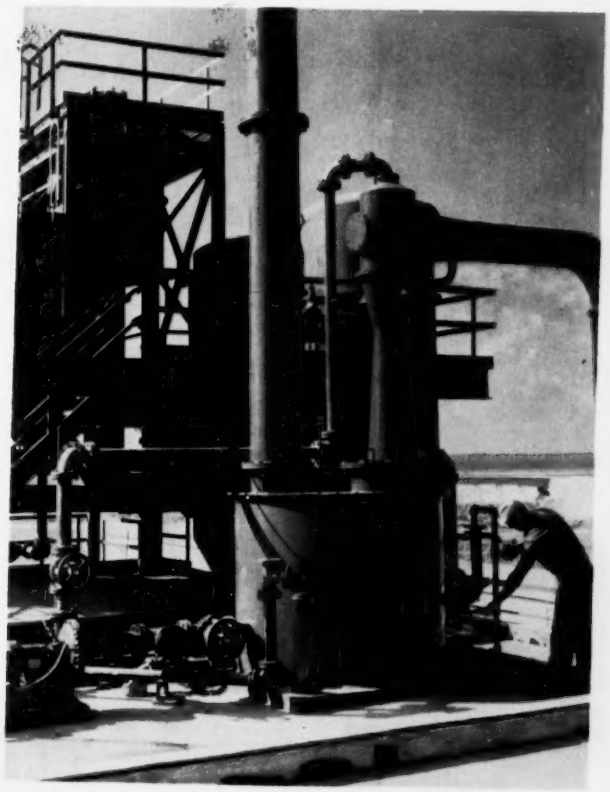
Centrifugal Separators

These three centrifuges break solvent-acid emulsion, separate the solvent and acid phases from the final extraction stage.



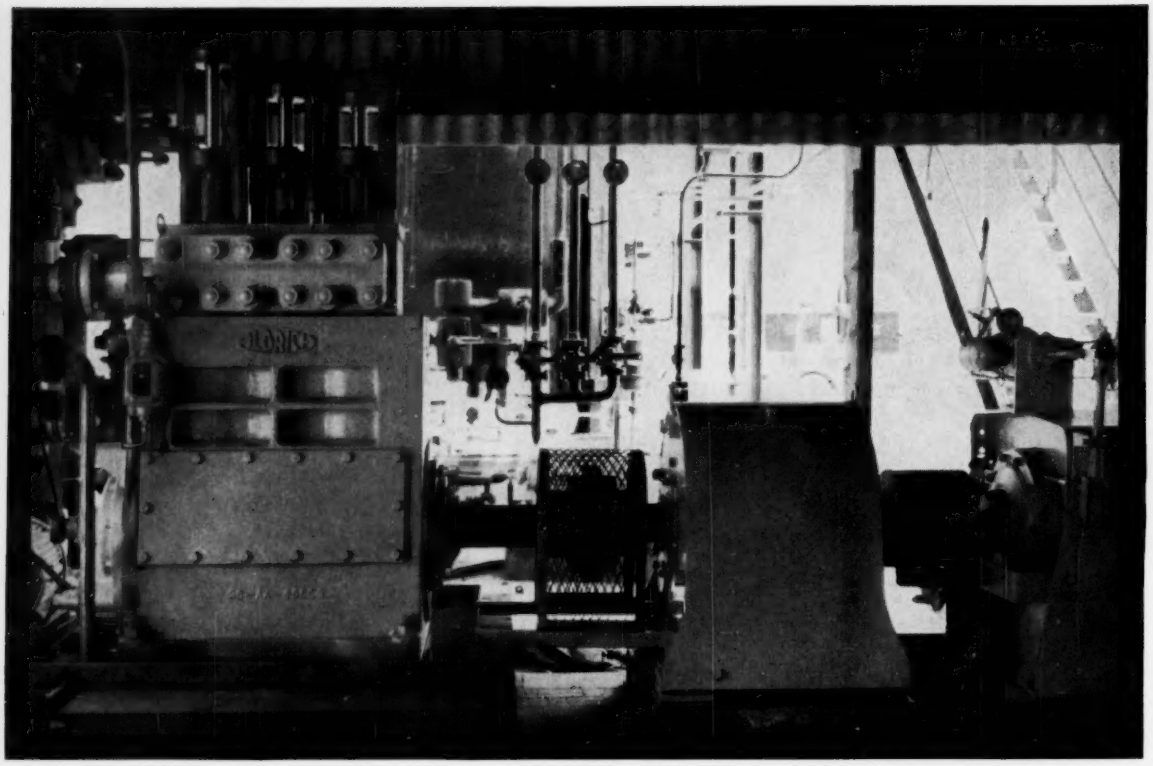






Scrubber Perched Atop Uranium Plant

Toxic hydrogen fluoride is washed out of exhaust gases from green-salt precipitation step. From the scrubber's high perch you may look down through a maze of wooden troughs, that carry highly corrosive acid, and you get a bird's-eye view of the plant.



THE PRESSURES ARE HIGH...THE LIQUIDS CORROSIVE...THE PUMPS ARE ALDRICH...

At the Houston plant of Rohm & Haas Co., this Aldrich pump alternately introduces caustic and brine into one phase of the acrylate process for producing acrylic monomers.

The problem: Handle highly corrosive liquids at 3000 psi in a continuous process and *not* have severe maintenance problems.

What Rohm & Haas did about it. Company engineers specified Aldrich 1⅝" x 5" stroke Triplex Pumps for three reasons.

1. Compact, heavy-duty construction makes Aldrich pumps ideal for high pressure service.

2. Aldrich pumps are designed for easy maintenance. Fluid-end sectionalization permits quick removal of valves for inspection or replacement. No special tools are required.

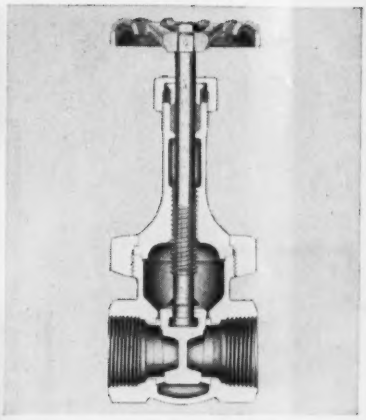
3. Aldrich engineers can draw upon a vast store of experience when it comes to selecting the right materials for any pumping job. In this case, the entire fluid end . . . working barrel, suction and discharge manifolds . . . are forged Monel. Valve seats are Haynes Stellite. Valves and plungers are K Monel.

Results: According to the Plant Manager of the Houston plant, "maintenance requirements have decreased and pumping production improved. These Aldrich pumps lend themselves to easy maintenance."

How Aldrich can help you. Solving pumping problems like this requires specialized engineering skills and experience. We have those skills, and our experience comes from years of working with the chemical industry. We welcome the opportunity to discuss your specific problems . . . no matter what the liquid or how high the pressures. Aldrich Pump Company, 3 Gordon Street, Allentown, Pa.

the toughest pumping problems go to ALDRICH

Expanded-type body rings. Made from Crane Exelloy—a 12% chromium stainless steel. Provide a hard surface that resists abrasive damage, indentation and scoring by foreign matter. Rings are rolled in, can't work loose. Seating wear is taken by easy-to-replace bronze disc.



Quality in every detail inside and out. In rising and non-rising stem patterns—¼ to 3 inches—screwed ends. Working pressures: 200 lb. steam, 550° F.; 400 lb. non-shock cold water, oil, gas and air, 150° F.

Cylindrical body shape. Proved on high-pressure steel valves. Increases body strength without adding bulk. Distributes pressure uniformly. Reinforces seating area against distortion and chance for leaks.

12% chromium stainless steel seat rings make Crane 200-pound bronze gates last longer

Here is a close-up of Crane quality that shows you why these 200-pound bronze gate valves perform more dependably than ordinary bronze valves, with less maintenance.

For example, instead of integrally cast seats, they have long-wearing 12% chromium stainless steel body rings. Rings are rolled in... can't work loose in service. This also prevents leakage around rings. The quickly replaceable bronze disc takes normal seating wear.

Crane 200-pound bronze valves are competitively priced with bronze valves which do not have these and other important features. Why pay for less than Crane offers you? For complete facts, see your Crane Representative.

Write for Circular AD-2285. Gives complete technical data on both rising and non-rising stem patterns.

CRANE® VALVES & FITTINGS

PIPE • PLUMBING • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

Fine Grinding for the CHEMICAL AND PROCESS INDUSTRIES

RAYMOND MULTI-PURPOSE ROLLER MILL WITH WHIZZER AIR SEPARATION

TYPICAL PRODUCTS PULVERIZED ON RAYMOND ROLLER MILLS

PIGMENTS . . CHEMICAL LIME . . FULLERS EARTH . . INSECTICIDES . . IRON OXIDES . . TALC . . BARYTES . . CLAYS . . SULPHUR . . CARBON MIXTURES . . SYNTHETIC RESINS . . AGSTONE . . BAUXITE . . CALCIUM SILICATE . . MINERAL FILLERS . . PHOSPHATE MATERIALS . . MAGNESIUM SULPHATE.

For further details, refer to Raymond Roller Mill Catalog #79

THIS modern combination of the Raymond High Side Roller Mill with double Whizzer Separator offers a versatile and economical unit for handling today's many fine grinding problems.

Its broad field of application covers all industries wherever the preparation of powdered materials is involved . . . from simple fillers to fancy chemicals.

Fineness range from 20-mesh grades to products essentially all minus 325-mesh with easy control by a single adjustment of the Whizzer.

Available in various capacities up to 30 tons per hour or more for the Super Roller Mills. May be equipped with Flash Drying where moisture removal is required.

All operations combined in a clean dust-free automatic system . . . flexible installation readily adapted to plant layout . . . typical roller mill economy in operation and maintenance.

COMBUSTION ENGINEERING, INC.

Raymond Division

1112 W. BLACKHAWK ST.
CHICAGO 22, ILLINOIS

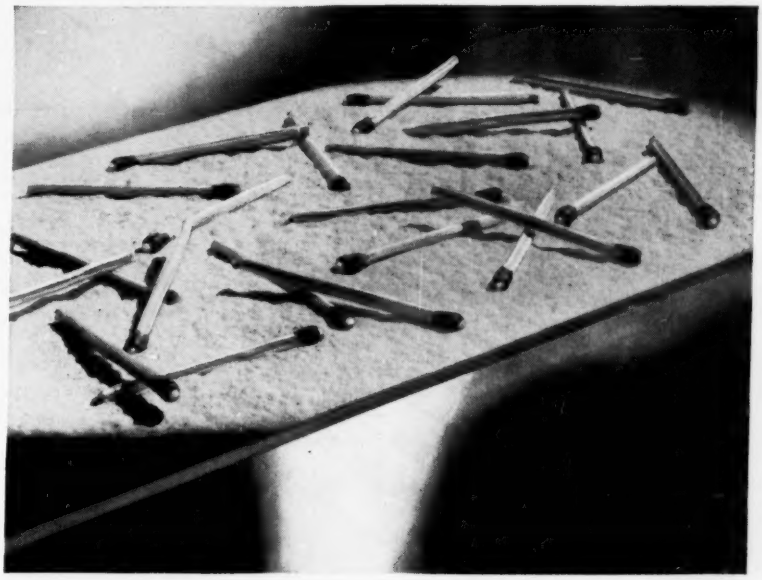
SALES OFFICES IN PRINCIPAL CITIES

Combustion Engineering-Superheater Ltd., Montreal, Canada

MgO spells opportunity

IMC reports on another outstanding property of its new High Purity MgO—remarkable heat resistance.

For many years, International's potash mining and refining operation at Carlsbad, New Mexico, has been producing large amounts of by-product magnesium chloride brine in conjunction with potassium sulfate. We are recovering values from this magnesium chloride by thermal decomposition to produce magnesium oxide. The product is better than 99% pure — highest purity ever achieved in carload lots.



Unbounded application

Heat resistance is one standout property. As a result, a firm is presently experimenting with it to develop a rocket nose cone capable of re-entering the earth's atmosphere. Another of its chief virtues is ease of handling, due to its low hydration rate.

Using MgO as an addition or substitution, many chemical process industries have been able to impart desirable — and hitherto unattainable — properties to their products. To elaborate:

- Improving the physical and chemical characteristics of magnesia has resulted in substantial savings. Using MgO as an extender, it's possible to obtain a high purity blend at low cost.
- Chemical manufacturers are making high-purity magnesium salts and chemicals from International magnesium oxide because of its relatively low cost and easily controlled reaction rates.
- By replacing ordinary alkali precipitants with MgO, several plants have been able to increase their process efficiency and reduce production costs.

Among its other applications: Electric furnace fusion for high temperature applications . . . in high-grade ceramic and glass formulations . . . for acid neutralization and uranium ore treatment . . . in thermocouples . . . as a substitute for alumina. Due to its low boron content, this International product has been the main source of MgO for U.S. Atomic Energy Commission applications. And the limits of its potential are nowhere in sight.

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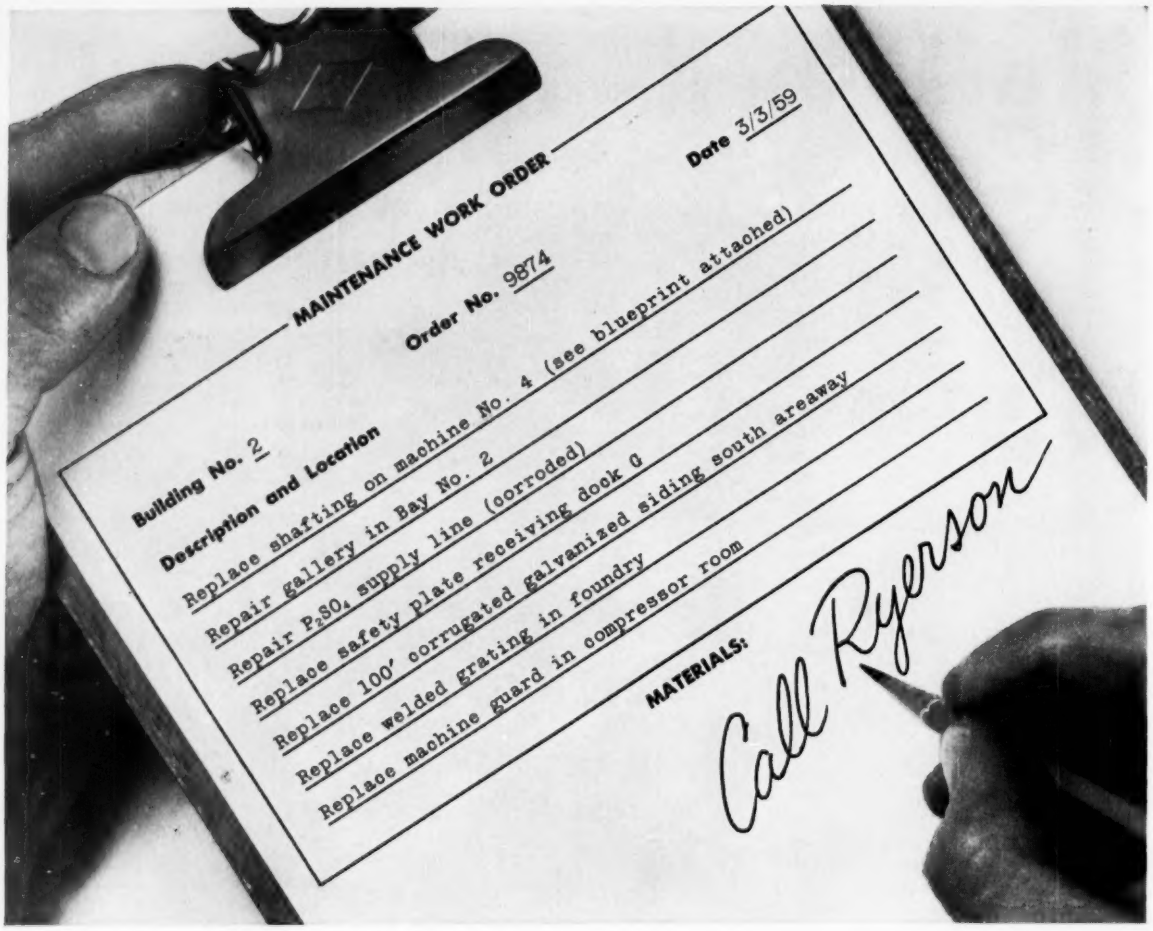

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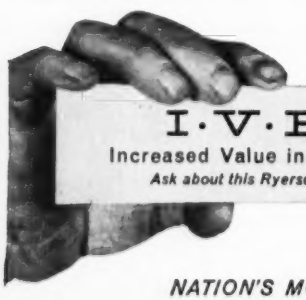

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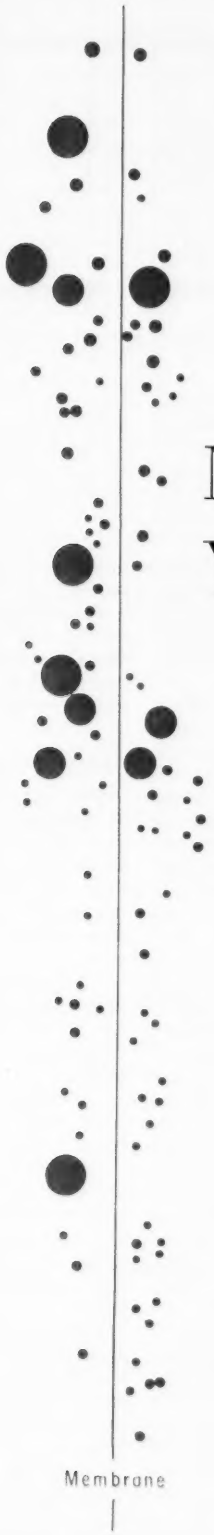


For Your Separations Repertoire:

Make Dialysis Part of Your Unit Operations

With New Acid-Resistant Membranes

N. S. CHAMBERLIN and B. H. VROMEN,
Graver Water Conditioning Co., New York

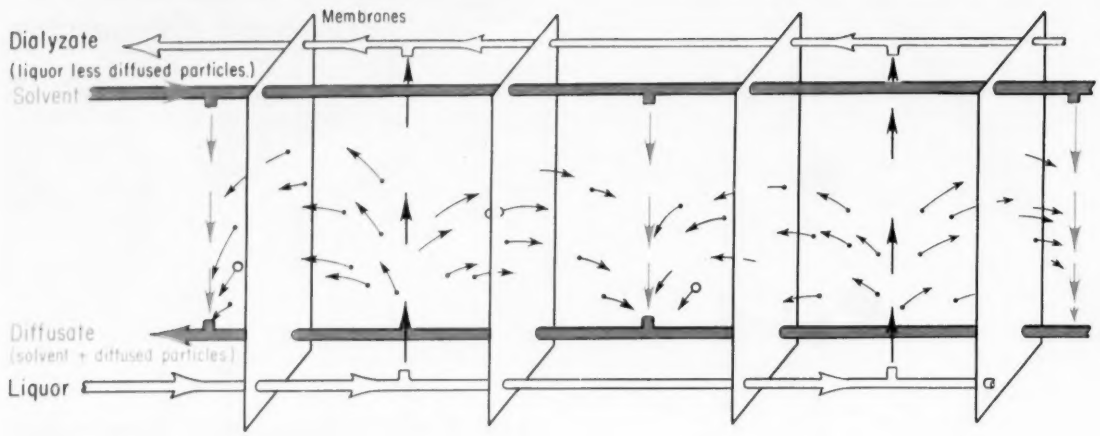
DIALYSIS, as a unit operation, has received increased attention in the past year as a result of development of acid-resistant vinyl membranes. The only commercial application of the separation technique heretofore—and it dates from the 1930's—has been recovery of caustic from alkaline steep liquors in the viscose rayon industry.

Mechanism of dialysis is selective liquid diffusion through a porous membrane. In diffusion, the molecules of two solutions of different chemical composition in contact intermingle gradually and spontaneously. This mass transfer of all dissolved substances, with no application of external energy, continues until equilibrium.

The "driving force" of diffusion, then, is a concentration gradient. The dissolved substances move from their high to low concentrations. Other conditions being equal, small and light molecules transfer at a higher rate than large, heavy molecules.

In dialysis, a porous membrane separates two solutions of different composition. Pores of the membrane are large enough for a molecule to pass through, but small enough to prevent hydrodynamic flow. Diffusion is normally, therefore, the only mechanism for mass transfer, and small, light molecules "dialyze" at a higher rate than large, heavy molecules. (In some

Countercurrent Dialysis Eases Separations



cases, however, the membrane pores are small enough to offer mechanical resistance to larger molecules. Such a semipermeable membrane facilitates separation, but it is not a necessary prerequisite for dialysis.)

In the simplest case of dialysis, a membrane separates pure solvent and a starting liquor containing two solute species. Solute moves into the solvent compartment by diffusion. The solvent plus diffused solutes — the diffusate — contains more of the lighter solute than of the less-mobile, heavy molecules.

This batch dialysis limits effectiveness of separation at best to equal concentrations of a solute in the two compartments. Continuous countercurrent dialysis overcomes the limitation, improving separation. Concentration of the more-mobile solute in the diffusate can become nearly as high as its concentration in the liquor.

Equip for Dialysis

Dialyzers are the equipment in which dialysis takes place. They hold the permeable or semipermeable membranes in place and contain and properly distribute the counterflowing solutions. Characteristics of the membrane material determine dialyzer design. Development of such design has produced three distinct types of dialyzer:

- The Cerini dialyzer in which impregnated membrane bags hang in a tank of liquor, solvent passing on inside of the bags.[3, 9]
- A tank-type in which membrane tubes are supported vertically in the tank.[3, 4, 9]
- A filter-press-type in which membranes are held between alternate liquor and solvent frames in a plate-and-frame arrangement.

In the Cerini dialyzer, the membranes (usually mercerized cotton) require rigid, permanent support. In early filter-press dialyzers, design for compactness and ease of assembly was dictated by the fragile cellulosic film membranes. Filter-press dialyzers had heavy cast heads and follower plates that could be brought together under screw pressure. Gaskets between the frames prevented liquid leakage.

Among present-day filter-press dialyzers are the Dutch Kooij dialyzer and, in the United States, the Graver "Hi-Sep" dialyzer. Like other units, the Hi-Sep is designed for the type of membrane it uses. Because the membrane allows a high rate of separation, all features of the unit enhance high-rate operation. Design and operating characteristics have already been covered in *Chemical Engineering*.[7]

The only power requirement for the dialyzer is that for pumping. Parts in contact with liquid are chemically resistant — frames, as well as membranes, are made of acid-resistant plastics. Countercurrent and cross flow produce maximum mass transfer. Flow through the unit is indicated above.

Spiral separators are used on the liquor side to maintain effective operating area in each cell and to permit a slight pressure differential to increase mass transfer.

Applying Dialysis

The first large-scale application of dialysis was recovery of caustic soda in the viscose rayon industry. Press liquor that is dialyzed contains colloidal hemicellulose and the unreacted caustic soda. Dialysis was chosen for the following reasons:

- Reclaiming caustic provides appreciable bookkeeping credit to the process in value recovered and elimination of troublesome waste product.
- Separation of caustic soda from hemicellulose is impractical by any other operation.
- Sodium hydroxide has a high diffusion coefficient; colloidal hemicellulose diffuses more slowly.
- Alkaline solutions offer no severe equipment corrosion or cellulosic membrane deterioration problems.

Caustic recovery is still a successful commercial application of dialysis, though designing units with the required large membrane area has been a formidable task. Further applications have awaited development of membranes that combine satisfactory strength and

permeability characteristics with suitable chemical resistance. With the Hi-Sep membrane, the list of possible applications for acid separation alone includes the following:

- Sulfuric acid, from liquors in the processing of nonferrous ores, refining of nonferrous metals, production of titanium pigments, iron and steel finishing.
- Hydrochloric acid, from liquors in extraction processes and pickling.
- Hydrofluoric and hydrofluosilicic acid, from liquors in tantalum-columbium metallurgy finishing operations, from lead refining.
- Nitric acid, from liquors for solvent extraction in metallurgical operations, from photo-engraving processes and metallic etching.
- Chromic acid, from liquors in etching and engraving-metal cleaning, from anodizing.

In these and other operations, it may be economically sound to recover the metallic salts as well as the acid. Such is the case in a metal refining plant where dialysis separates sulfuric acid and nickel sulfate. Mother liquor feeds to the dialyzer. Recovered acid is a solution containing 80 to 100 g./l. of sulfuric acid that is returned to the process. Purified mother liquor returns to the crude nickel sulfate crystallizer. An analysis of dialyzer streams is presented in Table I. This recovery has been possible at an installed cost of about $10/year-ton of sulfuric acid diffusion capacity.

In general, for mineral acid effluents, recovery of up to 90% of the acid in the liquor can be achieved. Acid recovered in the diffusate will be in a 10 to 60% solution, depending upon the liquor concentration. As an example, a liquor of 500 g./l. of sulfuric acid gives a diffusate of 450 g./l. or 35% sulfuric acid. On a per-hour basis, from several hundred pounds up to a half-ton of acid can be recovered by each dialyzer.

Dialysis may also prove to be useful in the removal of salts and inorganic acids from such products as gelatin, glue, latex, sugar and protein. In these and other cases where concentrations may be low, a careful bench-scale dialysis study may be required to determine feasibility.

Dialysis offers interesting possibilities in combination with ion exchange. In the regeneration of an ion exchanger, it is generally true that several equivalents of acid are required for each equivalent of metal extracted by the resin. Dialysis can separate the excess acid from the metallic salts of the effluent liquor. The acid diffusate returns to the resin cycle, and the dialyzate yields the metal or the metallic salt. A similar technique applies to combination processes involving solvent metal extraction.

Dialysis is applicable to any operation where acid, alkali or neutral salt liquors can be profitably separated for purposes of product recovery, purification and reuse. These conditions are found in most processing industries. Other separation operations may be more cumbersome, take longer and cost more than dialysis.

Selecting Membranes

The type of membrane used in a dialysis system determines the products that may be treated, the rate of separation and, in large measure, the economy of the operation. The ideal membrane should have no holes (to avoid hydrodynamic flow); high permeability, so that diffusional mass transfer can occur at the desired rate over a reasonable area of membrane surface; thinness, since the rate of diffusion of any substance between two solutions is inversely proportional to the film thickness; strength and durability.

Development, following use of the original parchmentized paper membrane, included improvement of parchment and use of cellulosic materials. The latter have a combination of properties that make them particularly suitable for dialysis. They can, to an unusual degree, imbibe water and aqueous

Analysis of Dialyzer Streams—Table I

	Liquor	Water	Dialyzate	Diffusate
Flow rate (gal./hr.)	400	400	420	380
Sulfuric acid (g./l.)	350	0	125	235
$CuSO_4$—Cu (g./l.)	30	0	26	2
$NiSO_4$—Ni (g./l.)	45	0	43	0

Compare Dialyzers and Membranes—Table II

Dialyzer	Liquor	Membrane	Diffusivity in Water, D × 10^5	Dialysis Coefficient, K	Effective Film Thickness
Cerini	Caustic	Cloth + Mg $(OH)_2$	1.7 sq. cm./sec.	0.196	0.25 in.
Marshall & Storrow	Caustic	Parch. Paper	1.7	0.87	0.057
Asahi	Caustic	Parch. Paper	1.7	1.05	0.047
Filter-Press	Acid	Parch. Paper	1.8	0.85	0.061
Filter-Press	Acid	Nalfilm 4	1.8	0.95	0.055
Graver Hi-Sep	Acid	Hi-Sep	1.8	2.50	0.021

solutions. They have a moderate degree of wet strength and are available in thin sheets. Shortcomings include susceptibility to chemical and biological degradation, and poor tear resistance. A high, localized stress produces rupture rather than plastic deformation.

Fortifying the cellulose with synthetic resins improves strength but lowers mass transfer capacity. These membranes, when used with acids, have to be replaced after a matter of days in use. Even with caustic they wear out or tear in two to four weeks.

Development of more suitable membranes awaited a new class of materials possessing—in common with cellulose—the ability to imbibe, while being superior in chemical resistance, toughness and strength. Such materials, now based primarily on vinyl polymers, followed from polymer chemistry research and engineering developments in commercial casting of strong, thin, tough and permeable resinous films.

New membranes were developed for electrodialysis of brackish and salt water to recover potable water. For this purpose, membrane permeability is less important than ion- or permselectivity. Earlier membranes allowed some diffusion of water-soluble materials although not enough to make them commercially attractive. Nevertheless, techniques established for production of permselective membrane materials led eventually to the first commercial synthetic resinous dialysis membranes.

The Hi-Sep membrane, used with the dialysis system recently introduced by our company, is made from synthetic resinous materials. Comparison with previous commercial membranes (Table II) shows that it is among the thinnest made. The new membrane has twice the mass transfer capacity of any other material that has been used commercially. In actual operation, these new membranes have trebled effective capacity of a dialyzer previously used with parchmentized paper membranes.

Reasons for increased membrane efficiency include greater transfer capacity; elimination of downtime (for replacement and repair); and increased chemical resistance allowing higher concentration of acid in the liquor feed. Their excellent chemical resistance alone provides the possibility of many new applications.

Diffusion Coefficients—Table III

Infinite Dilution, 20 C.

Acids	
Hydrochloric	2.6
Nitric	2.6
Sulfuric	1.8
Acetic	1.0
Phosphoric	0.9
Boric	1.1
Alkalis	
Sodium hydroxide	1.7
Potassium hydroxide	2.3
Lithium hydroxide	1.3
Calcium hydroxide	1.6
Barium hydroxide	1.5
Sulfates	
Sodium	0.8
Potassium	1.2
Zinc	0.6
Copper	0.6
Carbohydrates	
Sucrose	0.43
Lactose	0.43
Maltose	0.42
Dextrin	0.1
Gum Arabic	0.2
Starch	0.08
Proteins	
	About 0.05
Nitrates	
Sodium	1.3
Potassium	1.5
Silver	1.4
Ammonium	1.5
Uranyl	0.7
Alkaloids	
Caffeine	0.5
Nicotine	0.5
Chlorides	
Ammonium	1.6
Sodium	1.3
Potassium	1.6
Calcium	1.2
Lithium	1.1
Nickel	1.1
Magnesium	1.1
Barium	1.2
Alcohols	
Methyl	1.28
Ethyl	1.0
Allyl	0.90
Propyl	0.87
Isobutyl	0.77
Glycerol	0.72
Isoamyl	0.69
Mannitol	0.53

(All values are sq. cm./sec. $\times 10^{5}$)

Temperature Affects Diffusivity—Table IV

	Temperature, °C.	Diffusivity, Sq. Cm./Sec.
Acetic Acid	9.0	0.76×10^{-5}
	12.5	0.82
	17.0	0.92
	18.0	0.96
Sodium Chloride	5	0.9×10^{-5}
	10	1.0
	15	1.2
	18	1.3
	20	1.3
	25	1.6
	30	1.7

Compare Membranes

Let's consider the relationship of the actual performance of a membrane-and-dialyzer combination with that which is theoretically possible. Hi-Sep membranes are 0.0042-in. thick. The greatest possible transfer capacity is that which is obtained by hydrodiffusion (i.e., diffusion with no membrane) through a layer of solution of this same thickness.

From the dialysis coefficient K which is obtained experimentally, and from the diffusion coefficient D, we may compute a thickness L of a layer which under conditions of hydrodiffusion would yield the

same mass transfer. L will always be greater than actual membrane thickness. No film material can transfer mass by diffusion at the same rate as a layer of the solution by hydrodiffusion—this would require a zero-resistance membrane film. Furthermore, there is a stagnant layer on either side of the membrane which imposes additional hindrance to the diffusional transfer.

The fifth column of Table II shows a comparison of performance of various dialyzer-and-membrane combinations as reported in the literature.

Effective film thickness, in the last column of Table II, is the thickness of a stagnant film of pure water that has the same effective resistance to mass transfer as the series combination of the dialysis membrane and stagnant liquid films. The most effective combination shown, that of the Graver dialyzer with Hi-Sep membrane, yields an effective film thickness of 0.021 in.

Mindick has reported that permeability of the Hi-Sep membrane is 0.30, that is, a film of 0.0042-in. thickness is equivalent in diffusional resistance to a hydrodiffusional resistance of 0.0042 in./0.30 or 0.014 in. The difference, 0.021 − 0.014 or 0.007 in., is due to the liquid films on the two sides of the membrane.[5]

Forced circulation and various other means of minimizing liquid film resistances have been suggested and have appeared in the patent literature. These schemes improve dialyzer capacity but complicate design and operation. Filter-press design reduces film by providing extremely narrow channels for the countercurrent flow of the two solutions. In this way there is more effective agitation of the films by normal convective movement.

Design for Dialysis

Dialysis is a rate process, and as such can be treated with a design approach similar to other rate processes. The capacity W of a dialyzer can be expressed as

$$W = KA\Delta C_{lm} \qquad (1)$$

where W is lb./hr. of material transferred from liquor to diffusate through the membrane, A is effective membrane area in sq. ft., K is coefficient of dialysis in lb./(hr.)(sq. ft.)(g./ml.), and ΔC_{lm} is the log mean concentration gradient in g./ml.

The coefficient of dialysis can be estimated, but in the present state of the art it is almost always necessary to determine it experimentally for satisfactory design. Commercial pilot models are available for this purpose. The coefficient is dependent upon such factors as substance dialyzed, membrane properties, dialyzer design and temperature.

For a continuous countercurrent dialyzer, with no solute in the feed solvent, the driving force for mass transfer is

$$\Delta C_{lm} = \frac{(C_l - C_f) - C_d}{2.3 \log [(C_l - C_f)/C_d]} \qquad (2)$$

where C_l is concentration of diffusing solute in the liquor, C_f is its concentration in the diffusate, C_d is its concentration in the dialyzate, all in g./ml.

Study Your Separation

Assume that the liquor introduced to a dialyzer contains two solutes present in a concentration ratio $C_1/C_2 = R$, where C_1 refers to the concentration of the more mobile species present. In the diffusate both concentrations will be different and therefore a new ratio is found: $C_1'/C_2' = R'$.

The *separation* obtained here is $S = R'/R$. In general, the greater the value of S, the better the separation effected. In the case that $S = 1$, no separation is obtained. To compute the separation for any given system, it is necessary to know concentrations of the two substances C_1 and C_2 in the feed liquor and the corresponding dialysis coefficients K_1 and K_2, and then make use of Eq. (1).

When retention time of the feed liquor in the dialyzer is extremely short, only a small fraction of the dissolved substances is transferred through the membrane. Separation of the solutes attains a maximum: $S_{max} = K_1/K_2$. On the other hand, long retention time allows transfer of nearly all dissolved substances. The value of S approaches 1, and no separation takes place.

In any practical use of dialysis, a compromise can be made between these two extremes, balancing the separation required and the amount of liquor to be treated in equipment of an economically justifiable size.

Maximum separation S_{max}, also called the separation factor, can be estimated from the diffusion coefficients D_1 and D_2 of the solutes, since $K_1/K_2 = D_1/D_2$ for any given dialyzer and operating condition.

In Table III, values of D for various substances are given. The values are for dilute solutions only. Since diffusion coefficients vary with concentration, separation that might look unattractive in dilute liquors may be considerably improved at high concentration. In most cases, only laboratory tests with an actual dialyzer can determine whether dialysis can be applied profitably. Of course, whenever one component is a colloidal substance and the other component is not, a good separation can be predicted confidently.

All substances diffuse more rapidly at higher temperatures than at lower. It is generally true, however, that substances having low diffusivity have the highest temperature coefficients. Therefore, although a temperature rise increases capacity, it is accomplished at the expense of less separation. Table IV contains illustrations of the effect of temperature on diffusivity.

Higher temperatures may be employed when the separation factors

Diffusivity—Table V

Infinite Dilution, 25 C.

Ion	Ion Conductance, (Sq.Cm./Ohm)	Diffusivity, (Sq.Cm./Sec.) $D \times 10^5$
H^+	350	9.34
Li^+	39	1.04
K^+	74	1.98
Na^+	50.5	1.35
Cs^+	79	2.11
NH_4^+	75	2.00
Pb^{++}	73	0.98
Cd^{++}	54	0.72
Zn^{++}	54	0.72
Cu^{++}	54	0.72
Ni^{++}	52	0.69
OH^-	196	5.23
Cl^-	76	2.03
NO_3^-	72	1.92
$CH_3CO_2^-$	41	1.09
IO_3^-	41	1.09
$B_2O_3^-$	54	1.44
SO_4^{--}	81	1.08
$C_2O_4^{--}$	80	1.07
$Fe(CN)_6^{---}$	100	0.89
$Fe(CN)_6^{----}$	110.5	0.74

are high, as in separation of crystalloids from colloids or in the separation of acids or alkalis from salts. However, operating temperatures above 120 F. are usually not considered safe for the newer synthetic resin membranes. Lower temperature limits are imposed by solubility.

The diffusion coefficient of a solute is inversely proportional to the viscosity of the solution. The higher the viscosity of a solution, the thicker the stagnant film. Increased viscosity, therefore, adversely affects the dialysis coefficient to a greater extent than would be indicated by lowering of the diffusivity alone.

Diffusion of Electrolytes

Strong electrolytes in aqueous solution exist as cations and anions, each ion having a characteristic diffusivity. Where a concentration gradient exists, as across the membrane, the ion of the electrolyte having the greater diffusivity tends to separate from the ions having the opposite charge. This produces an electrostatic field in which faster moving ions are slowed, while slower moving ions are speeded. After attaining steady state, both types of ions diffuse at equal rates. Then the electrolyte moves with an "effective" diffusivity which may be expressed by

$$D_{eff} = \frac{(D_+D_-)\,(n_+ + n_-)}{(n_+D_+) + (n_-D_-)} \qquad (3)$$

where D_+ and D_- represent cation and anion diffusivities and n_+ and n_- represent numbers of cation and anion charges.

The effective diffusion coefficient of an electrolyte is a weighted mean of the diffusivities of its component ions. Thus diffusion coefficients of acids, alkalis and salts can be computed from values of the ionic diffusivities. Ion diffusivities are measurable by polarographic methods or calculated from ion conductances obtained by experiment.

It is possible, in the case of ionic solutes, to compute diffusion coefficients from the ion conductance of the ionic species i according to the formula

$$D_i = RT\,\mu_i/n_iF^2 \qquad (4)$$

where D_i is the diffusion coefficient in sq. cm./sec; μ_i is the ion conductance in sq. cm./ohm; n_i is the number of electric charges per ion; R is the gas constant, 8.317 volt coulombs/deg.; T is the temperature in deg. Kelvin; F is 96,500 coulombs.

At 25 C., $D = 2.67 \times 10^{-7}\,\mu/n$ sq. cm./sec. The diffusion coefficients at 25 C. of common ions at infinite dilution in aqueous solution, calculated by Eq. (4), are given in Table V.

From Table V and Eq. (3), the diffusion coefficient for sulfuric acid is 2.9×10^{-5} sq. cm./sec.; for nickel sulfate it is 0.84×10^{-5} sq. cm./sec. When solutions of sulfuric acid and nickel sulfate are dialyzed, the separation factor S_{mas} should be approximately 3.5 based on the ratio of acid and salt coefficients. Actually, the possible separation for this system is much greater than 3.5. In the dialysis of solutions of two or more electrolytes containing a common anion, maximum separation ratios are computed from the ratios of the individual cation diffusivities rather than taking the ratios of the diffusivities of the individual electrolytes.[8]

The maximum separation, then, should be the ratio of diffusivity of hydrogen ion to that of nickel or 9.34/0.69 = 13.5. Laboratory and commercial experience with this system indicates a ratio of from 11 to 13, showing substantial agreement between theory and practice. The separation of acids from salts appears to be one of the most promising commercial possibilities for the application of dialysis.

The same considerations apply, of course, in the case of competing anions of electrolytes having a common cation. In both cases, Table V is often more relevant to evalution of practical possibilities than Table III.

With the recent improvements in membrane materials and unit design, dialysis may play a new role in chemical processing operations. Simplicity and economy of operation recommend it, as do its high-rate characteristics and the availability of large-capacity commercial equipment.

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New Plants and Facilities In the Chemical Process Industries

Over 425 major new plants and expansions announced, under way or completed— from October 1957 through February 1959

* New plants include new cat crackers and reformers, extensive gas plant facilities, isomerization and alkylation units. Expansions refer to expansion of refinery crude throughput.

For complete listing, turn page

A CHEMICAL ENGINEERING REPORT

New Plants, New Facilities . . .

Who, Where & What

On these pages you'll find who's building what, and where . . . future markets for raw materials and equipment . . . future sources for products.

Ninth in Chemical Engineering's inventory of plants and facilities, this report lists 438 projects. They're major new chemical projects announced, under construction or completed in the U. S. from October 1957 through February 1959. No minor projects (less than $200,000) are included.

Listings have been compiled from many sources. They've been checked by *CE* editors for accuracy, completeness and current status.

For projects not included in this report, refer to tabulations of new plants and facilities compiled by *Chemical Engineering* and published annually since 1951.

See February 1951, 1952, 1953, January 1954, Inventory issues of 1954, 1955, 1956, 1957.

Fertilizers

Firm	Location	Products	Dollars	Job Status
American Potash & Chemical Corp.	Aberdeen, Miss.	Sodium chlorate	.....	15,000-ton/yr. plant on stream late 1958.
Best Fertilizer Co.	Lathrop, Calif.	Ammonia	.....	New 100-ton/day plant, on stream Jan. 1959, uses novel furnace, made by Selas Corp. of America, for steam reforming methane.
Bunker Hill Co.	Northwest U. S.	Phosphate fertilizer	10 million	Plant will be producing by July 1960, will use byproduct sulfuric acid from firm's metal-reduction plants at Kellogg, Idaho.
Calumet Nitrogen Products Co.	Hammond, Ind.	Anhydrous ammonia	.....	Production in 300-ton/day plant began in late 1957.
Coastal Chemical Corp.	Pascagoula, Miss.	Ammonia, ammonium phosphate	6.3 million	100-ton/day ammonia unit on stream early 1959; facilities on stream Dec. 1958, make 75 tons/day phosphoric acid, 350 tons/day granulated ammonium phosphate.
Cooperative Farm Chemicals	Lawrence, Kan.	Ammonia, urea	.....	New facilities will turn out 100 tons/day of ammonia and 30 tons/day of urea.
Farmers Liquid Fertilizer Co.	Patterson, Ark.	Liquid fertilizers	.....	New plant on stream early 1958.
W. R. Grace & Co.	Memphis, Tenn.	Urea	.....	300-ton/day plant due on stream early 1959.
Hooker Chemical	Columbia, Tenn.	Dicalcium phosphate	.....	Enlarged facilities in operation April 1.
Macco Corp.	Lathrop, Calif.	Ammonia	4.8 million	New 100-ton/day plant on stream late 1958.
Monsanto Chemical Co.	El Dorado, Ark.	Urea	.....	100-ton/day plant on stream in fall, 1958, making prill and solution urea products.
Monsanto Chemical Co.	Long Beach, Calif.	Sodium polyphosphate	.....	New plant on stream early 1959.
J. R. Simplot Co.	Pocatello, Idaho	Triple superphosphate, sulfuric acid	.....	Construction underway on 65% expansion of superphosphate capacity, to about 175,000 tons/yr.; 400 ton/day sulfuric acid plant under construction.
Southern States Cooperative	Russelville, Ky.	Granular fertilizer	750,000	60,000-ton/yr. plant due on stream spring 1959.
Southwestern Agrochemical Corp. First Mississippi Corp.	Chandler, Ariz.	Ammonia	4 million	60-ton/day plant, now abuilding, is designed to be nucleus of a chemical complex.
Spencer Chemical Co.	Henderson, Ky.	Urea	.....	100-ton/day plant on stream summer 1958.
Stauffer Chemical Co.	Richmond, Calif.	Pelletized superphosphate	350,000	Plant expansion, completed Mar. 1958, boosts capacity to 50,000 tons/yr.
SunOlin	North Claymont, Del.	Urea	11 million	Construction on 73,000-ton/yr. plant began in Mar. 1959.
U. S. Phosphoric Products	East Tampa, Fla.	Diammonium phosphate	.....	New 100,000-ton/yr. plant on stream mid-1959.
Western Phosphates	Garfield, Utah	Phosphate-ammonia fertilizer	500,000	Expansion boosts phosphate ore input about 10%.

Fine Chemicals

Firm	Location	Products	Dollars	Job Status
American Cyanamid	Bound Brook, N. J.	Anthraquinone, methyl anthraquinone, naphthaquinone	Multi-million	New plant scheduled to be on stream 1959.
Carter Products, Inc	Cranbury, N. J.	Toiletry and proprietary products	3.5 million	Scheduled for completion late summer 1959. plant will manufacture Carter products and Wallace Laboratories products.
Dow Chemical Co	Midland, Mich	Iminodiacetic acid		New facilities began production late 1958; acid finds use as intermediate for surface-active agents, complex salts and chelating agents.
Eli Lilly Co	Lafayette, Ind	Fine chemicals	5 million	New plant on stream early 1958.
Heyden-Newport	Fords, N. J.	Salicylaldehyde		1 million lb./yr. plant on stream 1958.
Merck & Co	Danville, Pa.	Monosodium glutamate	4.5 million	Plant completed 1958.
Miles Laboratories	Elkhart, Ind.	Citric acid	4.5 million	Construction under way, plant will be using company-developed submerged-fermentation process.
Norwich Pharmacal Co	Norwich, N. Y.	Antimicrobial nitrofuran		New plant in full production mid-1958.
Norwich Pharmacal Co	Norwich, N. Y.	Hydroxyethyl hydrazine	1 million	New plant completed early 1958.
Wyandotte Chemicals Corp	Wyandotte, Mich	Methyl pyrazine. 2,5-dimethyl pyrazine		Commercial plant on stream early 1958.

Heavy Organics

Firm	Location	Products	Dollars	Job Status
Air Reduction Co	Calvert City, Ky	Vinyl stearate		New 2-million-lb./yr. facility on stream about mid-1958.
Allied Chemical Corp	Frankford, Pa.	Naphthalene		Plant with capacity well over 100 million lb./yr. went on stream Oct. 1958.
American Chemical Corp	Watson, Calif.	Chlorinated hydrocarbons, vinyl chloride monomer	7.5 million	New plant now building.
American Cyanamid	Bound Brook, N. J.	Phthalic anhydride, maleic anhydride		New units scheduled to be on stream 1959.
American Cyanamid	Bridgeville, Pa.	Maleic anhydride	Multi-million	Completion of new plant slated for late 1959.
American Cyanamid	Willow Island, W. Va.	Aniline		24-million-lb./yr. plant on stream early 1958.
Amoco Chemicals Co	Joliet, Ill.	Phthalic anhydride, phthalic acids	10 million	60-million-lb./yr. plant constructed late 1958.
Ashland Oil & Refining	Buffalo, N. Y.	Benzene, toluene, xylenes		21-million-gal./yr. plant went on stream in April 1958.
Borden Chemica Co	Leominster, Mass.	Polyvinyl alcohol	1.5 million	Second 5-million-lb./yr. continuous process plant due on stream Oct. 1959.
Calcasieu Chemical Corp	Lake Charles, La.	Ethylene oxide		On stream in Jan. 1959. Plant engineered by Lummus Co. can produce 60 million lb./yr. of ethylene oxide or 8 million gal./yr. of ethylene glycol.
Celanese Corp. of America	Pampa, Tex.	Acetic acid		Doubling of capacity will boost output to 240 million lb./yr. in late 1959.
Diamond Alkali Co	Houston, Tex.	Perchlorethylene, acetylene		Perchlorethylene capacity expanded 50% in 1958, an acetylene plant was planned as of mid-1958.
Dow Badische Chemical Co	Freeport, Tex.	Acetylene chemicals		Plant slated to be on stream end of 1959.
Dow Chemical Co	Freeport, Tex.	Glycerine, allyl alcohol, allyl chloride		New glycerine plant on stream mid-1958, doubles capacity of 96% and 99.5% USP grades. Allyl alcohol unit on stream early 1958; allyl chloride, mid-1958.
Dow Chemical Co	Plaquemine, La.	Ethylene and propylene oxides and glycols		New facilities, part of $50-million project, on stream 1958.
Escambia Chemical Corp	Pensacola, Fla.	Methanol		16-million-gal./yr. plant on stream during the early part of 1958.
Esso Standard Oil Co	Baton Rouge, La.	Ethylene, propylene, industrial alcohols	46 million	Program completed to upgrade and expand output of petrochemical raw materials; 27,000-bbl./day Powerformer is now on stream.
Food Machinery & Chemical Co.	S. Charleston, W. Va.	Carbon tetrachloride		Expanded facilities were in operation by the middle of 1958.
B. F. Goodrich Chemical Co	Calvert City, Ky.	Glacial acrylic acid		Multimillion-lb./yr. unit went on stream early in 1958.

Heavy Organics—continued

Firm	Location	Products	Dollars	Job Status
Heyden Newport	Fords, N. J.	Pentaerythritol		25 million-lb./yr. unit on stream early 1958.
Humble Oil & Refining	Baytown, Tex.	Ethylene, paraxylene		80-million-lb./yr. ethylene recovery plant completed 1958; paraxylene capacity expanded to 9 million lb./yr. 1958.
Jefferson Chemical Co.	Port Neches, Tex.	Ethylene, ethylene glycol		Expansion triples ethylene capacity, doubles glycol capacity, boosts oxide capacity by 50%.
Jefferson Chemical Co.	Port Neches, Tex.	Ethylene oxide		60-million-lb./yr. plant, engineered by Scientific Design, went on stream late 1958.
Kolker Chemical Corp.	Newark, N. J.	Phthalic anhydride, methyl chloride		12-million-lb./yr. anhydride plant to be completed mid-1959; 9-million-lb./yr. methyl chloride plant on stream early 1958.
Mobile Oil Co.	Beaumont, Tex.	High-purity ethylene, propylene, butadiene	25 million for first stage of construction	380-million-lb./yr. plant will be built and operated by Magnolia Petroleum Co.
Monsanto Chemical Co. and Emery Industries	Nitro, W. Va.	Refined tall oil rosin, fatty acids		3,000-ton/mo. fractionating unit on stream mid-1958.
Monsanto Chemical Co.	St. Louis, Mo.	Fumaric acid		Capacity doubled April 1958.
Pennsalt Chemicals Co.	Wyandotte, Mich.	Methylamine		Plant completed late 1958.
Petroleum Chemicals, Inc.	Lake Charles, La.	Ethylene, propylene		200-million-lb./yr. plant on stream late 1958, uses process developed by Lummus Co.
Petro-Tex Chemical Corp.	Houston, Tex.	Isobutylene		2-million-gal./yr. high-purity plant on stream Dec. 1958.
Pittsburgh Coke & Chemical Co.	Neville Island, Pa.	Fumaric acid		2-million-lb./yr. plant on stream Nov. 1958.
Process Chemicals Co.	Los Angeles, Calif.	Ethylene oxide condensation products		4.5-million-lb./yr. unit, on stream early 1958, makes condensation products with nonyphenol, 2-ethyl hexanol, long chain alcohols and various amines.
Reichhold Chemicals, Inc.	Elizabeth, N. J.	Phthalic anhydride	5 million	30-million-lb./yr. plant, built by Badger Mfg. Co., slated for completion fall of 1959.
Reichhold Chemicals, Inc.	Hampton, S. C.	Formaldehyde		30-million-lb./yr. unit on stream mid-1958.
Reichhold Chemicals, Inc.	Tacoma, Wash.	Pentachlorophenol		Plant capacity doubled mid-1958.
Reichhold Chemicals, Inc.	Tacoma, Wash.	Phenol	4–5 million	60-million-lb./yr. plant now under construction.
Richfield Oil Corp.	Los Angeles, Calif.	Benzene		18-million-gal./yr. plant on stream late 1958.
Shell Chemical Corp.	Deer Park, Tex.	Phenol		Plant construction, begun early 1959, is slated for completion late 1959.
Shell Chemical Corp.	Dominguez, Calif.	Isopropyl alcohol		Expanded facilities in operation late 1958.
Shell Chemical Corp.	Norco, La.	Glycerine	10 million	As part of over-all project, firm is building acrolein plant.
Sinclair Chemicals Co.	Houston, Tex.	Paraxylene	6 million	New aromatics-recovery unit, on stream mid-1958, turns out 50 million lb./yr. of paraxylene.
Sinclair Chemicals Co.	Marcus Hook, Pa.	Propylene		New high-purity propylene facilities, on stream last year, supply raw material to Hercules Powder Co.'s polypropylene plant at Parlin, N. J.
Standard Oil Co. (Calif.)	Richmond, Calif.	Paraxylene		Plant on stream late 1958.
Stauffer Chemical Co.	Henderson, Nev.	Trithion insecticide		Capacity doubled in late 1958.
Stauffer Chemical Co.	Richmond, Calif.	Eptam herbicide		Multimillion-lb./yr. facility on stream Jan. 1959.
Stepan Chemical Co.	Chicago, Ill.	Dimethyl sulfoxide		New plant in full production early 1959.
Texas Co.	Los Angeles, Calif.	Benzene, toluene		9,000-bbl./day Udex unit scheduled on stream 2nd quarter 1959.
Union Carbide Chemicals Co.	Institute, W. Va.	Epoxides		Expanding capacity to 10 million lb./yr. of epoxides and other oxygenated chemicals.
Unnio Carbide Chemicals Co.	Institute, W. Va.	Ethylene oxide		Capacity was increased by 60 million lb./yr. in 1958.
Union Carbide Chemicals Co.	Seadrift, Tex.	Alcohols, esters		100-million-lb./yr. capacity increase slated for completion in 1960.
U. S. Steel Corp.	Clairton, Pa.	Benzene, toluene, xylene		Coal chemical facilities, processing 150,000 gal./day of coal-tar light oil, on stream Oct. 1958.
U. S. Steel Corp.	Gary, Ind.	Naphthalene		Naphthalene recovery facilities on stream June 1958.
Witco Chemical Co.	Chicago, Ill.	Phthalic anhydride		20-million-lb./yr. unit, engineered by Scientific Design, on stream early 1959.
Wyandotte Chemicals Corp.	Geismar, La.	Ethylene oxide-glycol		New plant on stream May 1958.
Wyandotte Chemicals Corp.	Wyandotte, Mich.	Propylene oxide		New plant on stream 1958.

Inorganics

Firm	Location	Products	Dollars	Job Status
Air Products, Inc	Phoenixville, Pa	Oxygen		New 7.5-million-cu.ft./mo. unit on stream mid-1958 feeds Phoenix Iron & Steel Co. works.
Air Reduction Co	Arlington, Tex	High-purity oxygen and nitrogen	400,000	Gas-producing plant completed as of Jan. 1958, has storage for acetylene and argon.
Air Reduction Co	Denver, Colo	Oxygen, nitrogen	600,000	Plant on stream Jan. 1959.
Air Reduction Co	Kansas City, Kan	Oxygen, nitrogen		Plant will supply an additional 5 million cu. ft./mo. to the Kansas City area.
Air Reduction Co	Lorain, Ohio	Oxygen		Plant expansion boosts capacity to 100 tons/day.
Air Reduction Co	South Acton, Mass	Liquid oxygen, nitrogen, argon	9 million	75-ton/day plant on stream mid-1958.
Allied Chemical Corp	Anacortes, Wash	Sulfuric acid	1 million	New plant supplies acid to adjacent Shell refinery.
Allied Chemical Corp	Baton Rouge, La	Soda ash		Plant capacity doubled early 1958.
Allied Chemical Corp	Baton Rouge, La	Sulfur hexafluoride		Major plant expansion completed early 1958.
Allied Chemical Corp	Brunswick, Ga	Caustic soda, chlorine		Capacity of mercury-cell chlorine-caustic plant doubled late 1957.
Allied Chemical Corp	Edgewater, N. J	Gypsum board		New unit, under construction, will calcine gypsum rock.
Allied Chemical Corp	Nitro, W. Va	Hydrofluoric acid		Construction on new plant started early 1958
Allied Chemical Corp	Richmond, Calif	Sulfuric acid		Plant expansion begun early 1959.
American Cyanamid	New Castle, Pa	Ammonium nitrate		New plant, on stream Sept. 1958, boosts capacity by 60%
American Potash & Chemical Corp	Trona, Calif	Boric oxide	800,000	Plant expansion slated for completion late 1959; boric acid expansion contemplated.
Anlin Co. of Illinois	Wood River, Ill	Sulfur	2 million	150-ton/day sulfur recovery plant due on stream mid-1959.
Arkansas Louisiana Chemical Corp.	Pine Bluff, Ark	Caustic soda, chlorine		Firm leased plant from Army after Diamond Alkali cancelled its lease in early 1958; daily capacity is 75 tons chlorine, 84 tons caustic.
J. T. Baker Chemical Co	Phillipsburg, N. J	Ammonium thiocyanate		Capacity increased as of mid-1958.
Carborundum Co	Niagara Falls, N. Y	Boron carbide		Expanded facilities in operation late 1958.
Columbia-Southern Chemical Corp.	Bartlett, Calif	Sodium carbonate and sesquicarbonate	Multi-million	New plant, on stream late 1958, triples output of older facilities, which were scrapped.
Delhi-Taylor Oil Corp	Grand County, Utah	Potash	20 million	Construction starting 1959 on mine and surface plant.
Diamond Alkali Co	Painesville, Ohio	Caustic soda, chlorine	2 million	Modernization replaces 30-yr.-old cells with Diamond's own 30,000-amp. cells.
Dixon Chemical	Newark, N. J	Aluminum sulfate		20,000-ton/yr. plant on stream early 1959, capacity expandable to 40,000 tons/yr.
Dixon Chemical	Paulsboro, N. J	Sulfuric acid	5.9 million	New plant now under construction.
Du Pont	Ecorse, Mich	Sulfuric acid		Plant under construction 1958.
Du Pont	Memphis, Tenn	Sodium, chlorine	Multi-million	Plant began operating late 1958.
Du Pont	New Johnsonville, Tenn	Titanium dioxide	30 million	New plant on stream Jan. 1959.
Freeport Sulphur Co	Louisiana offshore	Sulfur	30 million	Project designed to develop Grand Isle sulfur deposit; Y-shaped steel island nearing end of construction.
Fremont Minerals	Riverton, Wyo	Sulfuric acid	1 million	New 125-ton/day plant on stream late 1958.
Granite City Steel Co	Granite City, Ill	Oxygen		60-million-cu. ft./mo. oxygen unit built by Air Products feeds open-hearth furnaces.
Intermountain Chemical Co	Green River, Wyo	Soda ash		Plant and mine, operated for Intermountain by Westvaco, is being expanded by 20%, boosting capacity to 700,000 tons/yr.
Kaiser Aluminum & Chemical Corp.	Gramercy, La	Chlorine-caustic soda	8 million	114-ton/day caustic soda plant, 100-ton/day chlorine plant reached full capacity early 1958.
Linde Co	Duquesne, Pa	Oxygen		730-million cu. ft./mo. unit produces 99.5% oxygen for U. S. Steel plant.
Linde Co	East Chicago, Ind	Oxygen, nitrogen		Plant expansion completed 1958.
Linde Co	Gary, Ind	Oxygen, nitrogen		Now abuilding, plant at Gary Works of U. S. Steel will make 94 million cu. ft./mo. oxygen and 256 million cu. ft./mo. dry nitrogen.
Linde Co	Houston, Tex	Nitrogen		Storage facilities completed early 1958 store nitrogen in liquid form.
Linde Co	Huntsville, Ala	Liquid oxygen, nitrogen		100-million-cu. ft./mo. plant to be completed in 1960.
Linde Co	Middletown, Ohio	Oxygen		130-ton/day plant built for Armco Steel Corp

Inorganics, continued

Firm	Location	Products	Dollars	Job Status
Linde Co.	Monessen, Pa.	Oxygen	.....	Plant, operated by Linde for Pittsburgh Steel Co., on stream early 1958, makes 125 tons/day medium-purity oxygen, 14 tons/day high-purity oxygen.
Linde Co.	Pittsburg, Calif.	Liquid oxygen, nitrogen	.....	Completion of 300-ton/day plant scheduled for early 1960.
Linde Co.	Portsmouth, Ohio	Oxygen	.....	Unit on stream late 1958, makes up to 22 million cu. ft./mo. for Detroit Steel Corp. operations.
Linde Co.	Tulsa, Okla.	Nitrogen	.....	Storage facilities, similar to those at Houston, Tex., completed early 1958.
Liquid Carbonic	San Francisco area	Oxygen, nitrogen, argon, hydrogen	2.5 million	Plant at San Carlos producing hydrogen; plant at Oakland makes oxygen, nitrogen and argon.
Lockheed Missile Systems	Palo Alto, Calif.	Liquid helium	.....	Facilities began operating last year at Palo Alto laboratories, output going primarily to electronics firms.
A. R. Maas Chemical Co.	Richmond, Calif.	Phosphoric acid, phosphoric catalysts	1.5 million	New plant completed mid-1958.
Marblehead Lime Co.	Belle, Utah	Dolomite	3 million	New plant for dead-burned dolomite completed mid-1958.
Metal Hydrides	Beverly, Mass.	Lithium-aluminum hydride	.....	Plant capacity doubled late 1958.
Metal & Thermit Corp.	Hanover County, Va.	Titanium dioxide, rutile and ilmenite	1.3 million	Processing plant began operating late 1957.
Michigan Chemical Corp.	Port St. Joe, Fla.	Magnesia	.....	Completed plans, as of mid-1958, for a 125-150-ton/day seawater magnesia plant.
Mississippi Chemical Corp.	Yazoo City, Miss.	Nitric acid, ammonia	1.8 million	150-ton/day nitric acid plant on stream mid-1958; 30-ton/day ammonia plant on stream late 1958.
Monsanto Chemical Co.	Long Beach, Calif.	Sodium polyphosphate	.....	New plant on stream Mar., 1959.
Monsanto Chemical Co.	Monsanto, Ill.	Chlorosulfonic acid	.....	Plant expansion completed early 1959.
National Cylinder Gas	Erie, Pa.	Oxygen	.....	7.5-million-cu. ft./mo. unit, on stream early 1959, pipes oxygen to Erie Forge & Steel Co.
National Cylinder Gas	Kansas City, Kan.	Hydrogen	.....	Plant expansion early 1958 doubles hydrogen capacity.
National Cylinder Gas	Los Angeles, Calif.	Liquid oxygen, nitrogen, argon	1.8 million	Production, combined capacity to exceed 30 tons/day, began early 1959.
National Cylinder Gas	Philadelphia, Pa.	Oxygen, nitrogen, argon	3 million	Construction began mid-1958 on plant to pipe oxygen to Alan Wood Steel Co.'s H-iron plant at Conshohocken, Pa.
New Jersey Zinc Co.	Palmerton, Pa.	Sulfuric acid	.....	New facilities on stream 1958 up capacity by 40,000 tons/yr.
Northern Chemical Industries	Searsport, Me.	Ammonia, nitric acid	.....	Facilities make 125 tons/day of ammonia, 60 tons/day of nitric acid. Chemetron Corp.'s Chemical Div. is operating plant.
Olin Mathieson Chemical Co.	Beaumont, Tex.	Sulfuric acid, ammonium sulfate	.....	500-ton/day addition to sulfuric acid plant on stream 1958.
Olin Mathieson Chemical Co.	Saltville, Va.	Soda ash	1 million	Production and storage facilities for dense soda ash completed early 1958.
Pennsalt Chemicals Corp.	Calvert City, Ky.	Hydrofluoric acid	.....	Plant capacity increased 50% mid-1958.
Sherwin-Williams Co.	Coffeyville, Kan.	Barium monohydrate	.....	New plant, producing 99% pure monohydrate on stream fall of 1958.
Socony Mobil Oil Co.	Paulsboro, N. J.	Sulfur	.....	100-ton/day recovery plant on stream Sept. 1958.
Southern Oxygen Co.	Bladensburg, Md.	Liquid oxygen, nitrogen, argon	750,000	25-ton/day plant on stream early 1959.
Stauffer Chemical Corp.	Fort Worth, Tex.	Anhydrous HCl	.....	New plant, producing 99.5% pure product, on stream mid-1958.
Stauffer Chemical Co.	Niagara Falls, N. Y.	Caustic soda, chlorine	2 million	Expansion and modernization, to be completed late 1959, will boost capacity by about 25%.
Stauffer Chemical Co.	Richmond, Calif.	Tantalum and columbium pentachlorides	300,000	Semiworks plant now in operation.
Stauffer Chemical Co.	San Francisco, Calif.	Boric acid	500,000	Plant expansion boosted capacity 50%, as of Jan. 1958.
Sun Oil Co.	Toledo, Ohio	Sulfur	150,000	New 12.5-ton/day recovery unit on stream early 1959.
Texas Gulf Sulphur	Fannett Dome, Jefferson County, Tex.	Sulfur	.....	Production started June 1958.
United Heckathorn	Garfield, Utah	Fluorine chemicals	.....	3,000-ton/yr. plant on stream mid-1958; products are cryolite, aluminum fluoride, sodium fluoride and potassium aluminum fluoride.
U. S. Borax & Chemical	Wilmington, Calif.	Boric acid	.....	Plant expansion begun Oct. 1958.
U. S. Gypsum	Sperry, Iowa	Gypsum	.....	New gypsum manufacturing plant will be completed in 1960.

Inorganics, continued

Firm	Location	Products	Dollars	Job Status
U. S. Industrial Chemicals	Sunflower, Kan	Sulfuric acid		New sludge-acid burner, operating early 1958, handles 70 tons/day of spent acid, generates sulfur dioxide for conversion back to sulfuric acid.
United States Lime Products Corp.	Arrolime, Nev.	Calcium oxide	2 million	400-ton/day lime-processing plant on stream June 1958.
U. S. Steel Corp.	Clairton, Pa	Oxygen		22-million cu. ft./mo. unit, built by Air Products, on stream in fall 1958.
U. S. Steel Corp	Provo, Utah	Nitric acid, ammonia, ammonium nitrate		200-ton/day unit on stream early 1958.
Weyerhaeuser Timber Co	Longview, Wash	Chlorine		Capacity doubled to 140 tons/day end of 1958.
Wyandotte Chemicals	Geismar, La	Chlorine, caustic soda		First half of plant on stream early 1959, will produce 300 tons/day of chlorine and 330 tons/day of caustic.

Metals

Firm	Location	Products	Dollars	Job Status
Aluminum Co. of America	Massena, N. Y.	Aluminum		New facilities bring total capacity to 54,000 tons/yr. of aluminum.
Aluminum Co. of America	Point Comfort, Tex.	Alumina	45 million	Operations started Feb. 1959.
American Metal Climax, Inc.	Coldwater, Mich	Molybdenum, molybdenum-based alloys	1 million	New plant has capacity of 800,000 lb./yr. of castings.
Brush Beryllium Co.	Elmore, Ohio	Beryllium ingots		10,000-lb./mo. plant now operating.
Columbia-Southern Chemical Corp.	Pensacola, Fla	Zirconium		700,000-lb./yr. plant turns out hafnium-free zirconium; construction, by Badger Mfg., completed early 1958.
Dawn Mining Co	Ford, Wash	Uranium concentrates		400-ton/day mill on stream 1958.
Du Pont	Brevard, N. C.	High-purity silicon		New plant opened mid-1958.
Estes Park Beryllium Corp.	Drake, Colo	Beryllium		200-ton/day ore-processing plant planned.
Firth Sterling	Los Angeles, Calif	Tungsten carbide		New sintering facilities operating as of Jan. 1958.
Fremont Minerals, Inc	Riverton, Wyo.	Uranium concentrates		New 500-ton/day mill on stream 1958.
Gunnison Mining Co	Gunnison, Colo	Uranium concentrates	Over 2 million	200-ton/day mill on stream 1958.
Harvey Aluminum	The Dalles, Ore	Aluminum		New plant, on stream Sept. 1948, has capacity of 100 million lb./yr.
Homestake-New Mexico Partners.	Grants, N. M.	Uranium concentrates	5.3 million	750-ton/day mill on stream 1958.
Homestake-Sapin Partners	Grants, N. M.	Uranium concentrates	9 million	1,500-ton/day mill on stream 1958.
Kermac Nuclear Fuels Corp.	Grants, N. M.	Uranium concentrates	18 million	New 3,630-ton/day mill on stream early 1959· uses acid-leach circuit.
Kaiser Aluminum & Chemical Corp.	Ravenswood, W. Va.	Aluminum		New reduction plant; two potlines on stream 1958, with 72,000 ton/yr. capacity, two more potlines scheduled 1959.
Lakeview Mining Co.	Lakeview, Ore	Uranium concentrates	3 million	210-ton/day plant began operation early 1959.
Merck & Co	Danville, Pa	Silicon	5 million	25,000-lb./yr. plant completed late 1958.
National Metallurgical Co.	Springfield, Ore	Silicon	500,000	3,000-kw. electric furnace doubles capacity.
Ormet Corp.	Burnside, La	Alumina		345,000-ton/yr. plant on stream mid-1958; alumina is barged via Mississippi and Ohio Rivers to reduction plant near Clarington, Ohio.
Phillips Petroleum Co.	Grants, N. M.	Uranium concentrates	9.5 million	1,725-ton/day plant completed mid-1958.
Pittsburgh Coke & Chemical Co.	Neville Island, Pa	Ferromanganese	2.5 million	400-ton/day production began early 1958 from converted blast furnace.
Reynolds Metals Co	Sheffield, Ala	Aluminum	70 million	Construction of aluminum reduction plant completed about mid-1958.
St. Eloi Corp.	Cincinnati, Ohio	Rare metals (yttrium, scandium, europium)		Capacity expanded as of Oct. 1958.
Union Carbide Metals	Alloy, W. Va	Ferromanganese		New facilities completed late 1957 expand capacity six-fold.
Union Carbide Metals	Niagara Falls, N. Y.	High-purity vanadium		Production facilities for high-purity (ductile) metal tripled early 1959.
Union Carbide Nuclear	Rifle, Colo	Uranium concentrates	8.5 million	New 1,000-ton/day plant, on stream 1958, replaces old 300-ton/day plant.

Petroleum & Natural Gas Products

Firm	Location	Products	Dollars	Job Status
American Oil Co	Texas City, Tex	Refined petroleum		Second Ultraformer on stream June 1958, processes 21,500 bbl./day.
American Petrofina	El Dorado, Kan	Refined petroleum		New Platformer on stream early 1959.
American Petrofina Co. of Texas	Mount Pleasant, Tex	Refined petroleum	3 million	Platformer and alkylation unit added, other improvements now completed.
Atlantic Refining Co	Philadelphia, Pa	Refined petroleum		40,000-bbl./day vacuum flash unit on stream early 1959.
Atlas Processing	Shreveport, La	Refined petroleum		3,500-bbl./day pentane-isomerization unit, designed by Universal Oil Products, on stream late 1958.
Aurora Gasoline Co	Detroit, Mich	Refined petroleum		18,000-bbl./day vacuum unit scheduled on stream early 1959.
Bay Petroleum Corp	New Orleans, La	Refined petroleum		Refinery expansion, from 25,000 to 33,000 bbl./day, due to be completed in early 1960.
California Oil Co	Perth Amboy, N. J	Refined petroleum		10,000-bbl./day cat reformer, built by H. K. Ferguson Co., on stream in early 1959.
Carter Oil Co	Billings, Mont	Refined petroleum	1.5 million	Refinery crude capacity boosted from 25,000 to 34,000 bbl./day. 10,000-bbl./day distillate Hydrofiner due on stream May 1959.
Chemoil Corp	New Orleans, La	Refined petroleum	35 million	40,000-bbl./day refinery scheduled on stream late 1960.
Cities Service Oil Co	East Chicago, Ind	Refined petroleum	4 million	7,500-bbl./day catformer on stream late 1958.
Clark Oil & Refining Co	Blue Island, Ill	Refined petroleum		12,500-bbl./day cat cracker, constructed by Procon, due on stream 1959.
Clark Oil & Refining	Chicago, Ill	Refined petroleum	5 million	9,000-bbl./day expansion completed early 1958.
Columbia Hydrocarbon	Siloam, Ky	Natural-gas liquids	5 million	230-million fractionation plant on stream late 1958.
Commerce Oil	Jamestown, R. I	Refined petroleum		40,000-bbl./day refinery due June 1960.
Continental Oil Co	Lake Charles, La	Refined petroleum		52,000-bbl./day refinery planned as of mid-1958.
Cooperative Refinery Assn	Coffeyville, Kan	Refined petroleum	1.5 million	1,100-bbl./day alkylation unit, constructed by Treco, on stream summer 1958.
Derby Refining Co	Wichita, Kan	Refined petroleum	1.5 million	1,700-bbl./day alkylation unit scheduled on stream May 1959.
El Paso Natural Gas Co	Aneth, Utah	Gasoline	26 million	100-million-cu. ft./day gasoline plant planned as of early 1959.
El Paso Natural Gas Co	Jal, N. M	Natural gas products		100-million-cu. ft./day gasoline absorption plant on stream early 1959.
El Paso Natural Gas Co	Opal, Wyo	Natural gasoline	5-6 million	Construction started mid-1958 on plant to recover daily 83,000 gal. butane, 122,000 gal. propane and 62,000 gal. natural gasoline.
El Paso Natural Gas Co	Wingate, N. M	Gasoline		452,000-gal./day gasoline fractionation plant on stream early 1959.
El Paso Natural Gas Products	Odessa, Tex	Natural gas products		Alkylation-blending and dehydration plant on stream 1958.
Esso Standard Oil Co	Baton Rouge, La	Refined petroleum		27,000-bbl./day Powerformer on stream Sept. 1958; 10,000-bbl./day alkylation unit due on stream late 1958.
Esso Standard Oil Co	Everett, Mass	Refined petroleum		7,200-bbl./day Powerforming unit operating early 1958.
Farmer's Union Central Exchange	Laurel, Mont	Refined petroleum	3.8 million	5,100-bbl./day naphtha Unifiner, 7,100-bbl./day distillate Unifiner, 4,400-bbl./day Platformer on stream 1958, engineered and constructed by Universal Oil Products.
Fletcher Oil	Wilmington, Calif	Refined petroleum		Unifiner-Platformer on stream 1958.
General Petroleum	Torrance, Calif	Refined petroleum		Adding a fourth delayed coker, capacity 9,300 bbl./day, lifting total coking capacity to 35,000 bbl./day.
Gulf Oil Corp	Port Arthur, Tex	Refined petroleum		26,000-bbl./day cat reformer on stream mid-1958; 82,000-gal./day udex unit on stream early 1959. 10,000-bbl./day pentane isomerization unit under construction.
Gulf Oil Corp	Toledo, Ohio	Refined petroleum		2,000-bbl./day alkylation unit on stream early 1959.
Humble Oil & Refining	Baytown, Tex	Refined petroleum		43,200-bbl./day hydrodesulfurization unit, 6,000-bbl./day Hydrofining unit on stream 1958.
Humble Oil & Refining Co	Fluor Bluff, Tex	Natural gasoline	4 million	Extraction capacity expanded to 3.5 million cu. ft./day 1958.
Humble Oil & Refining Co	Kleberg County, Tex	Natural gas products	80 million	800-million-cu. ft./day gas processing and cycling plant planned for completion 1960.

Petroleum & Natural Gas Products, continued

Firm	Location	Products	Dollars	Job Status
Kerr-McGee	Wynnwood, Okla	Refined petroleum	5.5 million	5,500-bbl./day Platformer, 5,000-bbl./day naphtha Unifiner, 4,000-bbl./day distillate Unifiner on stream as of mid-1958.
Lion Oil Div. of Monsanto Chemical Co.	El Dorado, Ark	Refined petroleum	Multi-million	Expansion boosts crude throughout from 29,000 to 33,000 bbl./day, adds hydrodesulfurization, decarbonization and tetramer units.
Lone Star Producing Co	Atascosa County, Tex	Natural gas	3.75 million	100-million-cu. ft./day gas-treating plant on stream 1958.
Louisiana Chemical Corp. and Columbia Products	Magnolia, Ark	Ethane, natural-gas extraction products	3 million	Natural-gas extraction plant expanded to add ethane recovery facilities. Louisiana Chemical operates plant for Columbia Products.
Magnolia Petroleum Co	Beaumont, Tex	Refined petroleum		30,000-bbl./day Sovafiner on stream early 1960. 100,000-bbl./day distillation unit on stream early 1959.
Magnolia Petroleum Co	Cameron Meadows, La	Natural-gas liquids		150,000-cu. ft./day processing plant scheduled for completion Apr. 1959.
McBride Refining Co	Port Brownsville, Tex	Refined petroleum	2.5 million	12,500-bbl./day refinery expansion planned as of mid-1958.
National Cooperative Refinery	McPerson, Kan	Refined petroleum	1.6 million	Revamped crude, coking and alkylation units on stream late 1958.
Northwestern Refining Co	St. Paul Park, Minn	Refined petroleum	2.5 million	6,000-bbl./day catformer on stream early 1959.
Pacific Supply Cooperative	Vancouver, Wash	Refined petroleum		15,000-bbl./day refinery due for completion Mar. 1958.
Pan American Petroleum Co	Near Monahans, Tex	Natural gas		4-million-cu. ft./day plant on stream late 1958.
Pan-American Petroleum Corp	Riverton, Wyo	Natural gas liquids	2.5 million	New processing plant has capacity of 47 million cu. ft./day.
Pana Refining Co	Pana, Ill	Refined petroleum	1 million	1,870-bbl./day Platformer-Unifiner on stream late 1958.
Phillips Petroleum Co	Borger, Tex	Refined petroleum		34,000-bbl./day pentane isomerization unit, engineered by Universal Oil Products, on stream 1958.
Phillips Petroleum Co	Kansas City, Kan	Asphalt		Capacity expanded to 1,100 bbl./day in 1958.
Phillips Petroleum Co	Sweeny, Tex	Refined petroleum		16,000-bbl./day cat reformer and desulfurization units on stream 1958; 1,000-bbl./day hexane isomerization unit due on stream 1959.
Phillips Petroleum Co	Woods Cross, Utah	Refined petroleum	1.1 million	3,700-bbl./day cat reformer on stream 1958.
Richfield Oil Corp	Wilmington, Calif	Benzene, toluene	6.5 million	Unit, on stream mid-1958, turns out 18 million gal./yr. of nitration-grade benzene.
R & J Oil & Refining	Princeton, Ind	Refined petroleum		5,000-bbl./day crude unit, 1,700-bbl./day Platformer, 1,700-bbl./day Unifiner on stream by mid-1959.
Runnels Gas Products and Texas Gas Exploration	Eunice, La	Natural gasoline	500,000	Plant expansion, completed Apr. 1959, adds 60 million cu. ft./day natural gas capacity.
Shell Oil Co	Anacortes, Wash	Refined petroleum	Multi-million	New sulfuric acid alkylation unit started up early 1958, produces 800,000 bbl./yr. of aviation gasoline.
Shell Oil Co	Martinez, Calif	Refined petroleum	1 million	Expansion program includes new effluent control system, butane and jet fuel storage facilities.
Shell Oil Co	Wood River, Ill	Lube oils		Expansion of lube oil capacity to 4,000 bbl./day of finished oils.
Sinclair Refining Co	Corpus Christi, Tex	Refined petroleum		6,500-bbl./day cat reformer 5,400-bbl./day gasoline fractionator on stream 1959.
Sinclair Refining Co	East Chicago, Ind	Refined petroleum		18,000-bbl./day gasoline fractionation plant on stream mid-1958; 1,000-bbl./day MEK deoiling plant on stream fall of 1958.
Sinclair Refining Co	Houston, Tex	Refined petroleum		27,000-bbl./day gasoline fractionator, engineered by Fluor Corp., on stream 1958.
Skelly Oil Co	El Dorado, Kan	Refined petroleum		12,000-bbl./day vacuum unit on stream early 1959; 10,000-bbl./day Unifiner-Platformer, mid-1959.
Socony Mobil Oil Co	Buffalo, N. Y	Aviation alkylate		New 2,400 bbl./day unit on stream late 1957, produces alkylate from mixed propylene-butylene stream.
Socony Mobil Oil Co	East St. Louis, Mo	Refined petroleum		16,000-bbl./day pretreater, 12,000-bbl./day Sovaformer on stream 1959.
Socony Mobil Oil Co	Paulsboro, N. J	Refined petroleum		19,000-bbl./day delayed coker, 2,400-bbl./day alkylation unit, sulfur recovery plant due on stream late 1958-early 1958.
Standard Oil Co. (Calif.)	Bakersfield, Calif	Refined petroleum	4.5 million	5,000-bbl./day cat reformer on stream 1958.
Standard Oil Co. (Calif.)	El Segundo, Calif	Refined petroleum	1.5 million	300-bbl./day deisobutanizer on stream 1958.

Petroleum & Natural Gas Products, continued

Firm	Location	Products	Dollars	Job Status
Standard Oil Co. (Calif.)	Honolulu, Hawaii	Refined petroleum	.....	Construction of 32,000 bbl./day refinery began Oct. 1958; first processing units will be on stream near end of 1960.
Standard Oil Co. (Calif.)	Richmond, Calif	Refined petroleum	30 million	New facilities now abuilding are alkylation polymerization and isomerization units; 20,000-bbl./day cat reforming capacity on stream mid-1958; 40,000-bbl./day cat cracker due on stream July 1959.
Standard Oil Co. (Ind.)	Casper, Wyo	Refined products	.....	New 800-bbl./day lube oil plant operating, as of Jan. 1958.
Standard Oil Co. (Ind.)	Mandan, N. D	Refined petroleum	.....	1,630-bbl./day HF alkylation unit on stream late 1958.
Standard Oil Co. (Ind.)	Neodesha, Kan	Refined petroleum	.....	6,000-bbl./day Ultraformer on stream 1958.
Standard Oil Co. (Ind.)	Whiting, Ind	Refined petroleum	.....	New 140,000-bbl./day crude still due on stream 1959, 36,000-bbl./day vacuum tower on stream 1959, cat cracking due for 10,000-bbl./day expansion by 1960.
Standard Oil Co. (Ind.)	Wood River, Ill	Refined petroleum	.....	67,500-bbl./day crude unit, 30,000-bbl./day cat cracker on stream early 1959; 36,000-bbl./day vacuum-distillation tower on stream 1959.
Standard Oil (Ohio)	Cleveland, Ohio	Refined petroleum	3.4 million	3,000-bbl./day alkylation unit under construction 1958.
Standard Oil (Ohio)	Toledo, Ohio	Refined petroleum	40 million	60,000-bbl./day of refinery capacity on stream mid-1958.
Sun Oil Co	N. W. Okla	Natural gas liquids	3.5 million	100,000-gal./day recovery unit due on stream July 1959.
Sun Oil Co	Toledo, Ohio	Refined petroleum	1 million	Alkylation plant on stream 1958.
Sunshine States Refineries	East Tampa, Fla	Refined petroleum	20 million	20,000-bbl./day refinery planned for completion 1959.
Tennessee Gas Transmission	Lea County, N. M.	Natural-gas liquids	1.4 million	10-million-cu. ft./day processing plant on stream 1958.
Texas Co.	Anacortes, Wash	Refined petroleum	.....	45,000-bbl./day refinery on stream Dec. 1958.
Texas Co	Lawrenceville, Ill	Refined petroleum	.....	26,000-bbl./day feed preparation unit, 12,000-bbl./day hydrotreater, 12,000 bbl./day cat reformer, being built by Bechtel Corp., scheduled for completion late 1959.
Texas Natural Gasoline Corp. and Tennessee Gas Transmission	New Orleans, La	Natural gasoline	Over 3 million	150-million-cu. ft./day processing plant on stream late 1958.
Tidewater Oil Co	Avon, Calif	Refined petroleum	.....	New 1-million-bbl./day Houdriforming unit added late 1958.
Union Carbide Corp	Brownsville, Tex	.....	.....	In late 1958, Carbide bought from Amoco the Fischer-Tropsch plant originally built by Carthage Hydrocol; possible products are acetylene, ammonia, acrylonitrile.
United Fuel Gas Co	Kenova, W. Va	Natural-gas liquids	8 million	Extraction plant on stream late 1958.
United Refining	Warren Pa	Refined petroleum	1.5 million	Construction started mid-1958 to boost capacity from 8,000 to 15,000 bbl./day.
U .S. Bureau of Mines	Keyes, Okla	Helium	11 million	Plant, constructed by Fluor Corp., is scheduled to go on stream Aug. 1959, will extract 240 million cu. ft./yr. from natural gas.
Utah Oil Refining	Salt Lake City, Utah	Refined petroleum	2 million	35,000-bbl./day crude unit on stream 1958.
Vickers Petroleum Co	Potwin, Kan	Benzene, toluene, exylene	3.5 million	15-million-gal./yr. unit on stream mid-1958.
Warren Petroleum & Sunray	Forgan, Okla	Natural gasoline	3 million	100-million-cu. ft./day plant contemplated as of 1958.

Plastics & Resins

Firm	Location	Products	Dollars	Job Status
Air Reduction Co	Calvert City, Ky	Polyvinyl alcohol resins	12 million	New 20-million-lb./yr. plant expected on stream early 1960.
Air Reduction Co. and Mastic Tile Corp.	Calvert City, Ky	Vinyl chloride monomer, polymer	10 million	Plant, under construction by Blaw-Knox, is scheduled for completion early 1960.
Allied Chemical Corp	Buffalo, N. Y	Atomized polyethylene	.....	New facilities, installed in early 1958, boost production of atomized powder.
Allied Chemical Corp	Moundsville, W. Va	Vinyl chloride monomer	.....	Capacity doubled early 1958.
Allied Chemical Corp	Tonawanda, N. Y	Polyethylene	.....	Plant capacity increased mid-1958.

Plastics & Resins, continued

Firm	Location	Products	Dollars	Job Status
AviSun Corp	Port Reading, N. J	Polypropylene		Production of 30 million lb./yr. of polypropylene slated at polyethylene facilities leased from Koppers Co.
Borden Chemical Co	Illiopolis, Ill	Butadiene, styrene		New plant on stream late 1958 triples capacity.
Borden Chemical Co	Illiopolis, Ill	Coatings, adhesives	500,000	New plant construction begun late 1958.
Celanese Corp. of America	Belvidere, N. J	Polyvinyl acetate emulsions		20-million-lb./yr. plant completed May 1958.
Celanese Corp. of America	Bishop, Tex	Trimethylol propane		New 10-million-lb./yr. plant on stream early 1958.
Chippewa Plastics, Inc	Chippewa Falls, Wis	Polyethylene film	500,000	New plant begun operating late 1958.
Cosden Petroleum	Big Spring, Tex	Polystyrene	2 million	22-million-lb./yr. plant on stream mid-1958.
Crown Zellerbach Corp	Orange, Tex	Polyethylene film		Plant under construction June 1958.
Diamond Chemical Co	Deer Park, Tex	Vinyl chloride, copolymer		$10-million vinyl chloride plant on stream 1958; 25 million lb./yr. copolymer plant on stream late 1958.
Dow Chemical Co	Bay City, Mich	Linear polyethylene		Plant now under construction.
Dow Chemical Co	Freeport, Tex	Polyethylene		Plant capacity doubled late 1958.
Dow Chemical Co	Torrance, Calif	Foamed polystyrene		Plant capacity boosted 50% early 1958.
Du Pont	Belle, W. Va	Methyl methacrylate		Plant planned for completion late 1959.
Du Pont	Orange, Tex	Polyethylene		Plant, using Du Pont's own process, is due on stream in mid-1960.
Du Pont	Toledo, Ohio	Polyvinyl acetate emulsions		New unit on stream late 1958.
Eastman Kodak		Polypropylene		Plant projected.
Ethyl Corp	Baton Rouge, La	Vinyl chloride monomer		New facilities complete as of mid-1958.
Goodyear Tire & Rubber Co	Apple Grove, W. Va	Videne film	9 million	Plant under construction by Catalytic Construction Corp.
Goodyear Tire & Rubber Co	Point Pleasant, W. Va	Polyester resins	10 million	New plant planned as of 1958.
W. R. Grace & Co	Baton Rouge, La	Polyethylene, high density	18 million	Plant, engineered and constructed by Fluor Corp., came on stream late 1957.
W. R. Grace & Co	Owensboro, Ky	Vinyl acetate polymers and copolymers, styrene-butadiene latices	4 million	Construction started June, 1958, will more than double capacity.
Hercules Powder Co	Hercules, Calif	Urea		Urea capacity doubled in late 1958, 25% of 20,000-ton/yr. added capacity will go into resins.
Humble Oil Co	Baytown, Tex	Polypropylene		New 40-million-lb./yr. plant scheduled to start up late 1959.
Kendall Co	Columbia, Tenn	Polyethylene tape		Plant began operating late 1958.
Koppers Co	Woodbridge, N. J	Polyethylene		30-million-lb./yr. plant under construction in 1958.
Ludlow Papers, Inc	Orange, Tex	Polyethylene film		New plant planned as of June 1958.
Manhattan Adhesives Corp	Brooklyn, N. Y	Polyvinyl solutions and emulsions		New polyvinyl acetate and resins plant in full production late 1958.
Mobay Chemical Co	Martinsville, W. Va	Toluene diisocyanates		Plant capacity upped 50% in late 1958.
Monsanto Chemical Co	Springfield, Mass	Lytron 680 acrylic binder		Capacity doubled June 1958.
Monsanto Chemical Co	Springfield, Mass	Polystyrene		Capacity doubled May 1958.
Monsanto Chemical Co	Texas City, Tex	Styrene		40-million-lb./yr. additional styrene capacity on stream 1958.
Morningstar-Paisley	Clifton, N. J	Vinyl chloride		Production started early 1959.
National Petro-Chemicals Corp	Houston, Tex	Polyethylene		75-million-lb./yr. plant, engineered and built by M. W. Kellogg Co., was completed last year.
National Starch Products	Meredosia, Ill	Vinyl acetate polymer		Expansion will increase capacity by 50%.
Nopco Chemical Co	North Arlington, N. J	Urethane foam		Six-fold expansion slated.
Pennsylvania Industrial Chemical Corp.	West Elizabeth, Pa	Resins, aromatic solvents		New unit on stream early 1958.
Pittsburgh Coke & Chemical Co	Pittsburgh, Pa	Fumaric acid		New plant, on stream in late 1958, will make fumaric acid for plastics and resins.
Pittsburgh Plate Glass Co	Detroit, Mich	Polyester resins		New facilities on stream mid-1958.
Reichhold Chemicals, Inc	Ballardvale, Mass	Acrylic emulsions		Expansion boosts plant capacity to 10 million lb./yr.
Reichhold Chemicals, Inc	Ballardvale, Mass	Epoxy resins		10-million-lb./yr. facilities on stream May 1958.
Reichhold Chemicals, Inc	Detroit, Mich	Formaldehyde		35-million-lb./yr. plant planned as of mid-1958.
Reichhold Chemicals, Inc	Houston, Tex	Synthetic resins	1 million	Plant construction began late 1958.
Reichhold Chemicals, Inc	Tuscaloosa, Ala	Formaldehyde		35-million-lb./yr. unit planned in 1958.
Reichhold Chemicals, Inc	Kansas City, Kan	Formaldehyde	500,000	New 30-million-lb./yr. plant scheduled on stream Apr. 1959.

Plastics & Resins, continued

Firm	Location	Products	Dollars	Job Status
Reynolds Chemicals Corp	Whitmore Lake, Mich	Urethane foams, plastisol coatings		New plant, double the capacity of that at Ypsilanti, on stream late 1958.
Spencer Chemical Co	Orange, Tex	Polyethylene		90-million-lb./yr. unit on stream summer 1958.
Stepan Chemical Co	Millsdale, Ill	p-tert-butylphenol		Plant on stream as of Dec. 1958; product end use is primarily phenol-formaldehyde resins.
Texas Eastman	Longview, Tex	Polyethylene		Capacity upped to 85 million lb./yr. late 1958
Union Carbide	Cartersville, Ga	Polyethylene film		Plant, under construction, will be the fourth operated by firm's Visking Co. Div.
Union Carbide	Institute, W. Va	Polyethylene		On stream early 1958, 30-million-lb./yr. plant uses Ziegler porcess.
Union Carbide	Marietta, Ohio	Epoxies		15-million-lb./yr. epoxy unit planned as of mid-1958.
Union Carbide	Marietta, Ohio	Polystyrene film, epoxies		New facilities constructed in 1958.
Union Carbide	Seadrift, Tex	Polyethylene		On stream early 1958, 55-million-lb./yr. plant uses Phillips process.
Union Carbide	Whiting, Ind	Low-density polyethylene		New plant on stream mid-1959.
United Wallpaper	Chicago Heights, Ill	Varnishes, lacquers, resins		Plant opened late 1958.
U. S. Industrial Chemicals Co	Houston, Tex	Polyethylene		75-million-lb./yr. plant on stream in 1959; engineered by M. W. Kellogg Co.

Pulp & Paper

Firm	Location	Products	Dollars	Job Status
Boise Cascade Corp	Attalia, Wash	Pulp, paper containers	Multi-million	Container plant in operation in spring, 1958; pulp and paper facilities on stream 18–24 mo. afterwards.
Boise Cascade Corp	Wallula, Wash	Pulp and paper	15 million	New mill expected on stream early 1959.
Brown Co	Berlin, N. H	Specialty pulp products	5.3 million	Conversion to continuous magnesia-base pulping in Apr. 1958, aids pollution control, recovers pulping chemicals at 400-ton/day plant.
Brunswick Pulp & Paper Co	Brunswick, Ga	Chloride dioxide	3 million	Chlorine dioxide bleach plant, completed mid-1958, for use in pulp manufacture.
Buckeye Cellulose Corp	Foley, Fla	Cellulose pulp	Multi-million	Capacity doubled late 1958.
Champion Paper & Fibre Co	Fairfield, Calif	Pulp and paper		300-ton/day mill began construction mid-1958.
Container Corp. of America	Arlington, Tex	Folding cartons	2.5 million	Ready for occupancy in second half of 1959.
Crown Zellerbach Corp	Camas, Wash	Pulp and paper	800,000	New chlorine dioxide unit now being added to kraft bleach plant.
Eastern Corp	Lincoln, Me	Bleached kraft pulp	11 million	175-ton/day mill started mid-1958.
Gulf States Paper Corp	Demopolis, Ala	Bleached sulfate pulp		300-ton/day plant on stream late 1958.
Kerncot Fibre Corp	Buttonwillow, Calif	Pulp	Milti-million	Plant under construction mid-1958, converts cotton stalks into paper pulp.
Marathon Southern Corp	Naheola, Ala	Pulp, paper, paperboard	40 million	Mill on stream late 1958.
Noralyn Paper Mills	Donaldson, La	Newsprint		Construction started late 1958 on 150-ton/day plant; capacity can be upped to 250 tons/day
Olin Mathieson	Joliet, Ill	Corrugated paper board		30-million-sq. ft./mo. facilities under construction 1958.
Oxford Paper Co	Rumford, Me	Kraft pulp	15 million	Three-year improvement program includes: new 175-ton/day softwood kraft mill, new chlorine dioxide bleaching system, increase in hardwood kraft capacity from 250 to 350 tons/day.
Puget Sound Pulp & Timber Co	Bellingham, Wash	Pulping byproducts	400,000	Expansion includes doubling production of alcohol from lignin.
Rayonier	Jesup, Ga	Pulp, chemical cellulose	25 million	Second 100,000-ton/yr. plant opened early 1958
Southern Chemical Cotton Co	Chattanooga, Tenn	Industrial filtering apper		New 30,000-lb./day facilities will be completed late 1959.
West Virginia Pulp & Paper Co	Charleston, S. C	Paper		Plant capacity expanded to 150,000 tons/yr. of stretchable paper.
West Virginia Pulp & Paper Co	Luke, Md	Pulp and paper	50 million	Long-range building plans will add 750 tons/day to capacity over the next five years.
West Virginia Pulp & Paper Co	Torrance, Calif	Multiwall bags		New plant on stream mid-1958.

Rubber

Firm	Location	Products	Dollars	Job Status
Copolymer Rubber & Chemical	Baton Rouge, La.	Butadiene	.....	Plant capacity expanded to 35,000 tons/yr. late 1958.
Firestone Tire & Rubber Co.	Orange, Tex.	Butadiene	10 million	Plant capacity increased Jan. 1958 to 60,000 tons/yr.
Firestone Tire & Rubber Co.	Orange, Tex.	Polybutadiene, polyisoprene	.....	30,000-ton/yr. plant, now abuilding, can produce either polybutadiene (Diene) or polyisoprene (Coral).
Gates Rubber Co.	Nashville, Tenn.	Rubber tires	9 million	Tire manufacturing plant now under construction.
General Tire & Rubber Co.	Odessa, Tex.	Styrene-butadiene rubber	10 million	40,000-ton/yr. plant on stream late 1957.
Goodrich-Gulf Chemicals	Port Neches, Tex.	Synthetic rubber	.....	Plant expansion complete late 1958.
Goodyear Tire & Rubber Co.	Akron, Ohio	Synthetic latex	2.75 million	Capacity boosted to 27,500 lb./yr. in early 1958.
Humble Oil & Refining	Baytown, Tex.	Butyl rubber	.....	Capacity expanded to 13,000 tons/yr. early 1958.
Monsanto Chemical Co.	Springfield, Mass.	Styrene formulations	.....	Capacity doubled as of Aug. 1958.
Neches Butane Products	Port Neches, Tex.	Butadiene	.....	Capacity expanded to 300,000 tons/yr. mid-1958.
Odessa Styrene Co.	Odessa, Tex.	Styrene	.....	New plant completed mid-1958.
Petroleum Chemicals, Inc.	Lake Charles, La.	Butyl rubber	17 million	30,000-ton/yr. plant slated on stream early 1959.
Shell Chemical Corp.	Los Angeles, Calif.	Polyisoprene	.....	20,000-ton/yr. output scheduled end of 1959.
United Rubber & Chemical	Baytown, Tex.	Synthetic rubber	.....	New facilities on stream 1958.

Synthetic Fibers

Firm	Location	Products	Dollars	Job Status
Allied Chemical Corp.	Chesterfield, Va.	Nylon carpet staple	.....	Commercial production of Caprolan fiber began early 1958.
Allied Chemical Corp.	Hopewell, Va.	Caprolactam	.....	New units, on stream Jan. 1, 1959, bring monomer capacity to over 60 million lb./yr.
American Cyanamid	Fortier, La.	Acrylonitrile	25 million	100-million-lb./yr. plant on stream 1958.
American Cyanamid	Pensacola, Fla.	Creslan acrylic fiber	25 million	Production at 27-million-lb./yr. plant started late 1958.
American Enka Corp.	Enka, N. C.	Nylon	7.5 million	Plant expansion, due for completion in early 1960, will double capacity.
Chemstrand Corp.	Decatur, Ala.	Acrilan	.....	Capacity expanded to 45 million lb./yr. lat 1958.
Chemstrand Corp.	Pensacola, Fla.	Nylon	.....	Capacity expanded to 114 million lb./yr. in early 1958.
Dow Chemical Co.	Lee Hall, Va.	Zefran	.....	12–15 million lb./yr. plant (estimated) slatede to be on stream 1958.
Du Pont	Beaumont, Tex.	Caprolactam	.....	50-million-lb./yr. plant, using cyclohexane as raw material, is scheduled to go on stream in third quarter of 1960.
Du Pont	Old Hickory, Tenn.	Dacron	Multi-million	56-million-lb./yr. unit on stream mid-1959.
Du Pont	Richmond, Va.	Nylon	Multi-million	New plant to produce heavy-denier nylon tire cord on stream early 1958.
Du Pont	Waynesboro, Va.	Orlon	.....	40-million-lb./yr. plant on stream mid-1958.
Fiber Industries	Shelby, N. C.	Teron polyester fiber	.....	Construction now underway; eventual capacity will be 40 million lb./yr. Firm is owned by Celanese and Imperial Chemical Industries.
Foster Grant Co.	Manchester, N. H.	Nylon-6	1 million	Plant started full production mid-1958, producing over 3 million lb./yr.
Monsanto Chemical Co.	Texas City, Tex.	Acrylonitrile	.....	Expansion to 100 million lb./yr. completed 1958.
Ohio River Chemical Co.	Ashland, Ky.	Caprolactam	10 million	20-million-lb./yr. plant scheduled for late 1959 early 1960.
Rayonier	Hoquiam, Wash.	Cellulosic products	4 million	100-ton/day wood mill on stream early 1958.
Standard Oil Co. (Ohio)	Lima, Ohio	Acrylonitrile	.....	45-million-lb./yr. plant, under construction, uses process engineered by Sohio and Badger Mfg.
Union Carbide	Institute, W. Va.	Acrylonitrile	.....	Plant capacity doubled 1958.

Miscellaneous

Firm	Location	Products	Dollars	Job Status
American Cyanamid (Formica Corp.)	Farmville, N. C.	Flakeboard	5.5 million	New plant began operating late 1958, turns out 40 million sq. ft./yr.
American Gilsonite	Gilsonite, Colo.	Fuel oil, gasoline, coke	450,000	Plant expansion boosts capacity from 700 to 850 tons/day.
Arizona Portland Cement Co.	Ash Fork, Ariz.	Cement	12 million	2-million-bbl./yr. plant now in operation.
Armour & Co.	McCook, Ill.	Emulsifiers, detergents	.....	New ethoxylation plant on stream mid-1958.
Callery Chemical Co.	Muskogee, Okla.	Boron-based fuel	38 million	New plant started up 1958.
Carborundum Corp.	Keasbey, N. J.	Refractories	Multi-million	Expansion and modernization program launched late 1958.
Clinton Corn Processing Co.	Clinton, Iowa	Corn oil	.....	Corn germ processing capacity raised to 170 tons/day in 1958.
Columbia-Southern	Barberton, Ohio	Cement	.....	New plant makes 1.5 million bbl./yr. of cement.
Continental Carbon Co.	Ponca City, Okla.	Carbon black	.....	50% plant expansion, due for completion late 1959, will boost capacity to 75 million lb./yr
Dow Chemical Co.	Midland, Mich.	Specialty organic chemicals	500,000	New facilities added late 1958.
Eagle-Picher	Lovelock, Nev.	Diatomaceous filter aids	2.5 million	New plant completed about mid-1958.
Flintkote Co.	Louisville, Ky.	Cement	.....	Capacity of subsidiary Kosmos Portland Cement Co. scheduled for 45% increase by mid-1959.
General Carbon & Chemical Co.	Robinson, Ill.	Carbon	.....	Capacity of electrode-grade carbon boosted by 720 tons/day mid-1958.
General Mills	Minneapolis, Minn.	Epoxidized soybean oil	.....	Production of epoxidized oils began late 1958.
B. F. Goodrich Chemical Co.	Henry, Ill.	Antiozonant	.....	New unit slated to be on stream spring 1959.
HEF, Inc.	Columbus, Miss.	Ammonium perchlorate	.....	4-million-lb./yr. plant on stream early 1959; process can also turn out lithium perchlorate.
Hercules Powder Co.	Bacchus, Utah	Solid propellants	.....	New plant for double-based solid propellants planned in 1958.
Hooker Chemical Corp.	Columbus, Miss.	Ammonium chlorate	1 million	Expansion more than doubles firm's original 12,000-ton/yr. capacity, completed Apr. 1959.
International Minerals & Chemical Corp.	Greenville, Tenn.	Flake mica	.....	New facilities boosted production to 120 tons/day mid-1958.
Johns-Manville	Chicago, Ill.	Pressure-sensitive tapes and adhesives	.....	New plant opened Dec. 1958.
Kessler Chemical Co.	Philadelphia, Pa.	Glycerol monostearate, synthetic waxes, surface-active agents.	.....	A new second plant doubles production capacity.
Lehigh Portland Cement	Alsen, N. Y.	Cement	8 million	Expansion planned for production and storage facilities.
Metal & Thermit	Carollton, Ky.	Organometallics	3.5 million	2.5-million-lb./yr. plant on stream mid-1958.
Monsanto Chemical Co.	Seattle, Wash.	Vanillin	.....	Plant expansion, completed late 1958, boosts vanillin-from-lignin capacity by 25%.
Morton Chemical Co.	Weeks, La.	Adsorbent clay	.....	New plant, built by M. W. Kellogg Co., completed Dec. 1958.
Nevada Cement Corp.	Mill City, Nev.	Cement	3 million	Firm broke ground about mid-1958 for 500,000 bbl./yr. plant.
Olin Mathieson Chemical Co.	Mapleton, Ill.	Antifreeze	1.5 million	New plant under construction 1958.
Olin Mathieson Chemical Corp.	Model City, N. Y.	Boron-based fuels	46 million	New Air Force plant completed mid-1958.
Olin Mathieson Chemical Corp.	Niagara Falls, N. Y.	Organoborane fuels	4.5 million	New private plant on stream mid-1958.
Pennsalt Chemicals	Portland, Ore.	Ammonium chlorate	.....	New plant on stream late 1958; ammonium perchlorate used as oxidizer in solid propellants.
Pittsburgh Coke & Chemical Co.	Pittsburgh, Pa.	Activated carbon	.....	Major plant expansion began early 1959.
Pittsburgh Plate Glass Co.	Cumberland, Md.	Plate glass	34 million	New plant started up mid-1958.
H. K. Porter Co.	Cannon City, Colo.	Silica brick	.....	Unit, added mid-1958, boosts capacity by 50%.
Riverside-Arizona Cement Co.	Clarkdale, Ariz.	Cement	.....	1.5-million-bbl./yr. plant on stream in 1959.
L. Sonneborn Sons	Petrolia, Pa.	Microcrystalline wax	.....	Capacity increased 25% early 1958.
Stauffer Chemical Co.	Niagara Falls, N. Y.	Boron trichloride	.....	Plant on stream mid-1958.
Waverly Chemical Co.	Phillipstown, N. Y.	Surface-active agents	300,000	New facilities slated to be in operation late spring 1959.

Estimate Specific Liquid Volumes

From this one chart estimate specific liquid molal volumes over an extended range of T and P.

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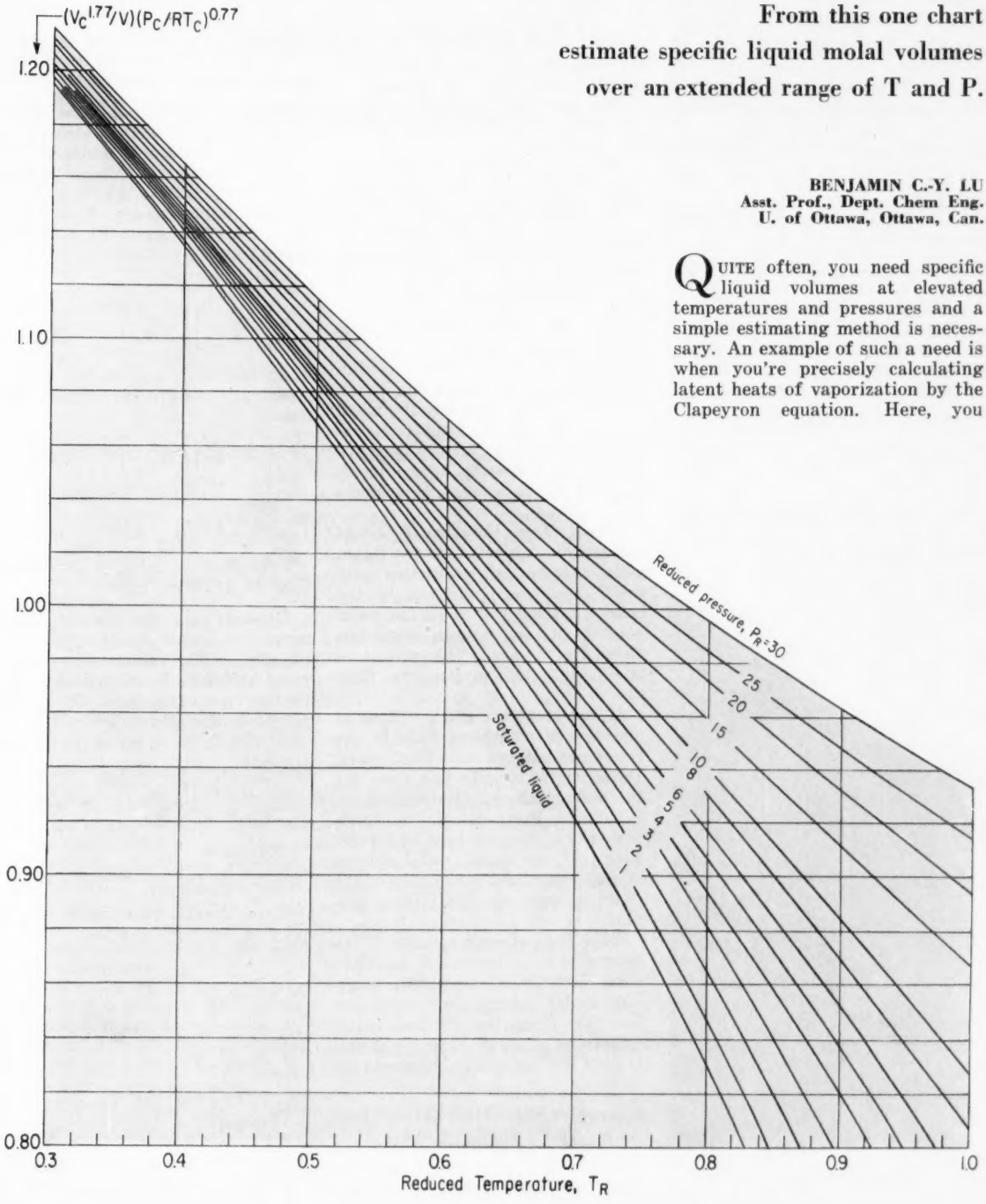
QUITE often, you need specific liquid volumes at elevated temperatures and pressures and a simple estimating method is necessary. An example of such a need is when you're precisely calculating latent heats of vaporization by the Clapeyron equation. Here, you



need the molal volume of the saturated liquid.

One recent method[4] modifies and improves the other methods[2, 5] for correlating reduced liquid densities by using the compressibility factor at the critical point Z_c.

The New Correlation

A generalized chart was developed to cover an extended range of temperature and pressure for estimating liquid molal volumes. This chart represents an empirical relationship developed from, and generalizing, the above-mentioned correlation using the critical compressibility factor Z_c.

At constant temperature and pressure:

$$\left[\frac{(Z_c)^{0.77}}{v_R}\right]=\left[\frac{(v_c)^{1.77}}{v}\right]=\left[\frac{p_c}{R\,T_c}\right]^{0.77}=K$$

This equation is valid for substances having Z_c values greater than 0.24. The majority of common organic compounds[4] have Z_c values between 0.26 and 0.28 and the rest between 0.18 and 0.31 so that most organic compounds are covered.

The chart was constructed using the above equation and data from the literature.[1, 2, 4, 5]

However, the chart doesn't hold when T_R approaches unity for saturated liquids and for liquids at $P_R = 1$. This is obviously because the reduced volume equals unity for all compounds at the critical point by definition, irrespective of the values of Z_c.

You can use the chart for estimating three volumes:

Liquid Molal Volumes—Within the correlated range of the chart, you can directly estimate the molal volumes of a liquid at any temperature and pressure. All you need are the critical properties of the liquid, namely, T_R, p_R and v_R. (Example 1.)

Liquid Molal Volumes, $Z_c < 0.24$—Here you can estimate the liquid molal volumes of substances over the T_R, p_R ranges covered by the chart provided you know the molal volume at one known condition since $K_1v_1 = K_2v_2$. This procedure is similar to that proposed by Watson.[5]

If you know the molal volume at one known condition, this is the recommended procedure in all cases. Deviation is usually less than for the method above. (Example 2.)

Critical Volumes—If you know the critical temperature and pressure and the liquid molal volume at one condition, you can use the chart to estimate the critical volume.

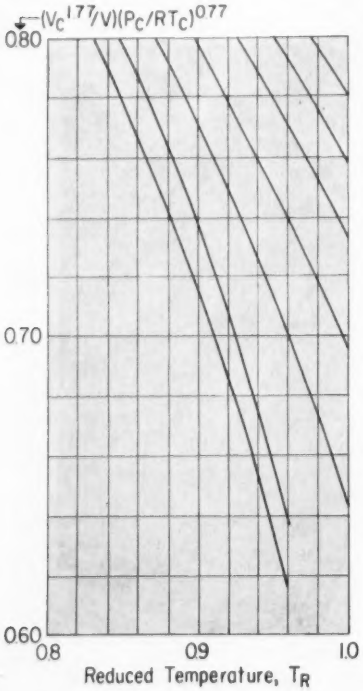
This method isn't reliable if the estimated v_c indicates a Z_c less than 0.24. Further, it's best if the available molal volume isn't measured too far from the critical point. Otherwise you can expect a deviation of 5% or more. (Example 3.)

Nomenclature

c	Critical condition (subscript).
p	Pressure.
T	Absolute temperature.
v	Molal volume.
R	Gas constant.
Z	Compressibility factor (pv/RT).

Molal Volume Chart Extended

$T_R = 0.80$ to 1.00



Examples Show How to Use Chart

Example 1: Estimate molal volume of ethyl ether at 80 C. and 500 atm. pressure. Critical properties of ethyl ether are: $p_c = 35.6$ atm.; $T_c = 467$ K.; $v_c = 281$; $Z_c = 0.261$.

$$T_R = (273 + 80)/467 = 0.756$$

$$p_R = 500/35.6 = 14.0$$

From the chart:

$$\left[\frac{(v_c)^{1.77}}{v}\right]\left[\frac{p_c}{R\,T_c}\right]^{0.7} = 0.975$$

Therefore: $v = 102.4$ cc./g.-mole.

Experimental value in the literature[3] is 104.4 cc./g.-mole.

Example 2: Estimated the molal volume (v_2) of methyl alcohol at 80 C. and 500 atm. pressure. Molal volume of methyl alcohol when saturated at 64.7 C. is 42.5 cc. (v_1). Critical properties are: $T_c = 513.2$ K.; $p_c = 78.5$ atm.; $Z_c = 0.222$. At 64.7 C., $T_R = 0.658$.

From the chart:

$$\left[\frac{(v_c)^{1.77}}{v_1}\right]\left[\frac{p_c}{R\,T_c}\right]^{0.77} = 0.955$$

At 500 atm. and 80 C., $T_R = 0.688$, $p_R = 6.37$. Now, from the chart:

$$\left[\frac{(v_c)^{1.77}}{v_2}\right]\left[\frac{p_c}{R\,T_c}\right]^{0.77} = 0.986$$

Therefore:

$$0.955\,v_1 = 0.986\,v_2$$
$$v_2 = 41.2 \text{ cc./g.-mole}$$

Experimental value in the literature[3] is 41.14 cc./g.-mole.

Example 3: Estimate critical molal volume of liquid ethyl propionate. Molal volume when saturated at 250 C. is 197.1 cc./g.-mole. Critical properties are: $T_c = 546$ K.; $p_c = 33.0$ atm.

At 257 C., $T_R = 0.958$. From the chart:

$$\left[\frac{(v_c)^{1.77}}{v}\right]\left[\frac{p_c}{R\,T_c}\right]^{0.77} = 0.618$$

Therefore:

$$v_c = 348 \text{ cc./g.-mole}$$
$$Z_c = 0.257$$

Experimental value in the literature[3] is 344.5 cc./g.-mole.

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3. "International Critical Tables," Vol. III, McGraw-Hill Pub. Co., New York, 1928.
4. Lydersen, A. L., R. A. Greenkorn and O. A. Hougen, "Generalized Thermodynamic Properties of Pure Fluids," Rept. 4, Eng. Expt. Station, Univ. of Wis., Oct., 1955.
5. Watson, K. M., *Ind. Eng. Chem.*, 35, 398 (1943).

Select Special Control Valves

. . . To handle fluids with unusual properties most effectively.

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SPECIAL valves may control flow of fluids having unusual properties. In this category are valves for controlling small flows; toxic, corrosive and valuable fluids; liquids containing abrasive materials; and slurries.

Other valve designs provide control for low pressure drop through valve at high fluid velocities; for mixing or diverting flow; and for large flows at low liquid pressures. Also, certain valve operators can provide additional power at valve stem to overcome unbalanced thrust forces on the valve plug.

Valve specification and maintenance of special and standard valves are further requirements to assure correct valve action and adequate flow control.

How to Handle Small Flows

A flow coefficient or C_v factor less than one is rarely available in conventional plug valves. Flow control at C_v factors less than one generally requires spline plug valves, needle valves or their equivalents. Fig 1 illustrates the spline plug, retainer and seat of the Microflo control valve. This valve is available in sizes corresponding to C_v factors ranging from 0.001 to 0.63. The valve has equal percentage characteristics for C_v factors between 0.1 and 0.63 and linear characteristics at smaller flows.

The section of the spline plug which moves inside the seat ring has slots or grooves milled and ground into the plug surface. Outside diameter of this section is one-quarter inch. Total stem travel is one inch. Even at maximum lift, the spline plug is guided through the full depth of the seat.

For maximum hardness, the spline plug and seat ring are made of Stellite alloy. For the extremely small openings in these valves, the effects of wire drawing and erosion increase. To minimize these effects, a material of suitable hardness is

* To meet your author, see *Chem. Eng.* March 9, 1959, p. 140.

Bellows Seal
Where toxic or valuable fluids need leakproof valves.

Venturi Throat
Handle high fluid velocities.

Three-Way
For variable-flow mixing.

Diaphragm Control
Easily handle slurries or corrosive fluids.

Butterfly
Large flow at low pressures.

Piston Operated Pneumatic
For high fluid pressures.

Spline Plug
For small flows.

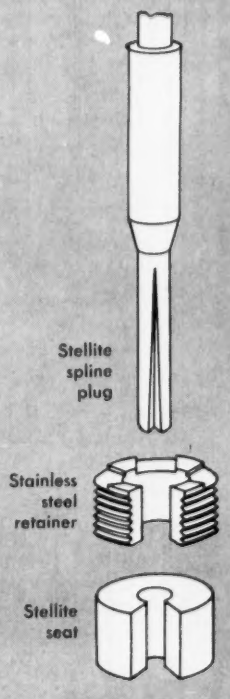


Fig. 1

necessary. A stainless steel retainer holds the valve seat in the valve body.

Consider Bellows-Seal Valves

Control valves are sometimes installed in pipelines handling toxic or valuable fluids. Here even minute leakage as may occur with ordinary packings cannot be tolerated. Hence, a bellows-seal is used to isolate valve stem action from the atmosphere. Bellows-seals are also helpful where the process fluid would solidify upon contact with air, or in vacuum service where air infiltration from the outside is not desirable.

A typical bellows-seal valve is shown in Fig. 2. The lower stem, to which the valve plug is connected, slides at its upper end in a hexagonal bushing. This hexagonal guide does not seal. Slots are provided in this guide to permit venting between valve body and the space between bellows and outside sealing tube. In addition to guiding the valve stem, the hexagonal guide prevents the stem from rotating, and thereby protects the bellows from damage.

For greater safety, a three-ply bellows consisting of three bellows closely fitting one into the other seals the valve stem. Inside the bellows, and concentric with the stem, is the bellows tube. This tube carries at its upper end the combination bellows tube collar and safety travel stop. Their purpose is to provide a rigid guide for the bellows and at the same time to limit the amount of contraction and expansion of the bellows to protect it from damage. In case of bellows rupture, the Teflon packing at the top provides an additional safety measure.

A pressure gage (telltale gage) may also be inserted between bellows and packing. A certain pressure variation will be indicated when the stem moves and changes the compression of air in this confined space.

Bellows Seal Stem Action

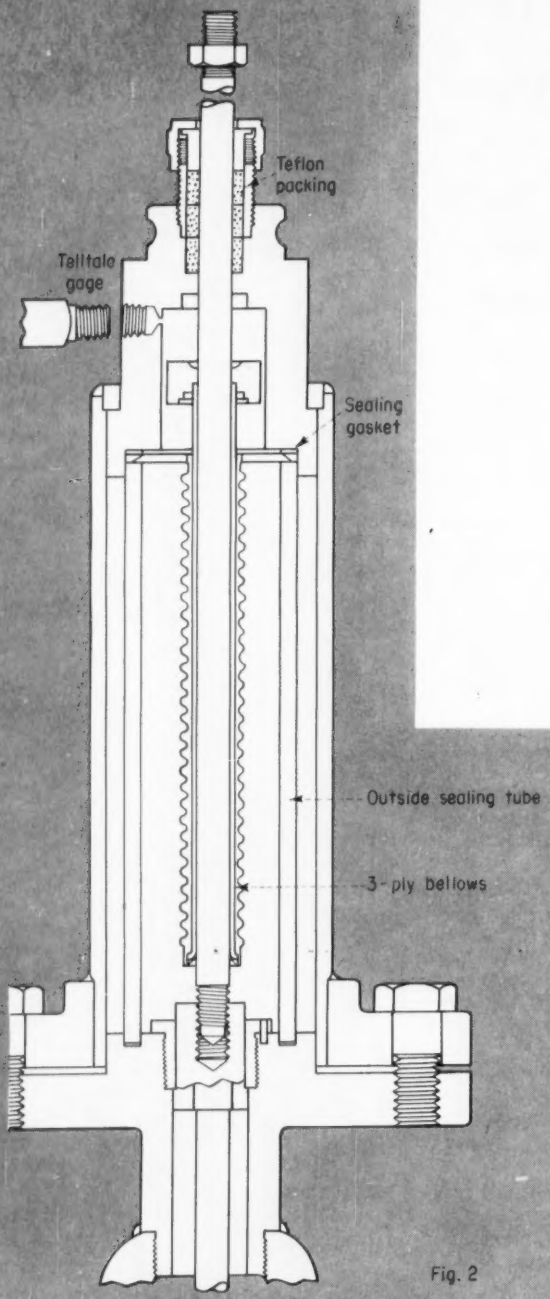


Fig. 2

Venturi Throat Limits Pressure Drop

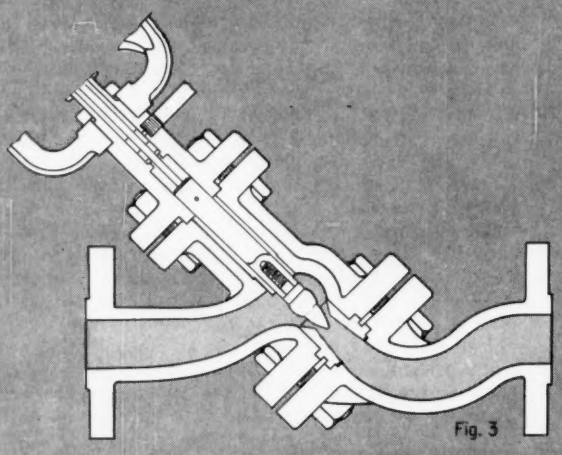


Fig. 3

A similar variation will be indicated when the temperature changes and expands or contracts the air in the same space.

If the bellows rupture, the pressure increase is more pronounced, providing the fluid pressure is high enough to indicate the change. The telltale gage can also be replaced by a pressure switch which closes an electrical alarm when the pressure exceeds a preset value.

Venturi Throat Valves

In any control valve, pressure loss should be concentrated across the inner port. Loss in the valve body should be reduced to a very small portion of the total pressure drop. For this requirement, the best solution is, probably, the venturi-throat control valve. An example of this type is shown in Fig. 3. These valves are generally used for high fluid velocities where pressure loss in the valve can have considerable magnitude.

The streamlined flow path through the venturi-throat valve prevents a sudden change in the direction of flow. This design also minimizes the destructive effect of solid particles suspended in the fluid as they impinge on valve body and outlet piping. Hence, the valve is a good choice for the control of fluids carrying abrasive material.

Venturi-throat valves have a C_v factor about 40% lower than the corresponding double-seated valve. Frequently, venturi-throat valves have to be chosen one size larger than the corresponding double-seated valve.

Split design of the valve body as shown in Fig. 3 permits easy removal of the valve seat for inspection or replacement. The right-hand half of the valve body can be turned and the valve converted from straight to angle type. This arrangement is sometimes preferred for easier installation where particular pipe configurations make a straight line installation difficult.

Split bodies also have disadvantages. They cannot be welded into the pipeline because accessibility of the valve plug and seat are then lost. Furthermore, pipe stresses, transmitted to the body bolting, can result in leakage or even damage to the body.

Use Three-Way Valve for Mixing

Valves of three-way construction are generally used to change the proportion of two fluids which are being mixed. In Fig. 4, two fluid streams may be mixed to give a resulting fluid. Increasing the air pressure on the diaphragm actuator increases flow of one fluid and decreases flow of the other, while total resulting flow remains approximately the same.

Another use of three-way valves is for diverting a stream into two separate streams.

In using three-way valves for mixing, the pressure drop across each port should have essentially the same magnitude to obtain satisfactory control. Also, the flow rate of either fluid should not change through more than a 5:1 ratio between maximum and minimum values.

Diaphragm Control Valves

A typical diaphragm control valve is shown in Fig. 5. Closure of the valve is effected by pressing a flexible diaphragm against a transverse ridge which is cast in the valve body. When fully closed, the diaphragm seats against the transverse ridge under pressure from the actuator which pushes down on the diaphragm and thus provides a leak tight closure. In gradually lifting the diaphragm, a variable flow area is produced which effectively controls the flow rate.

Three-Way Valves

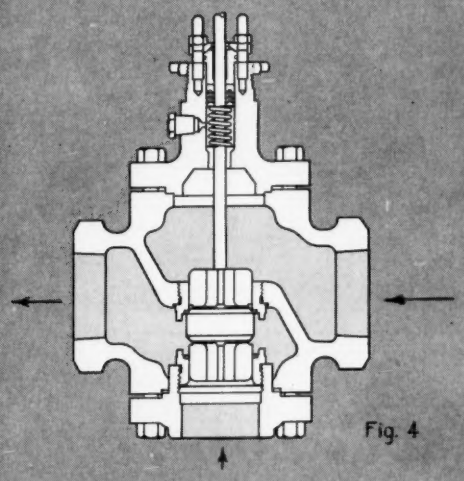


Fig. 4

Diaphragm Valve Gives Leak-Tight Closure

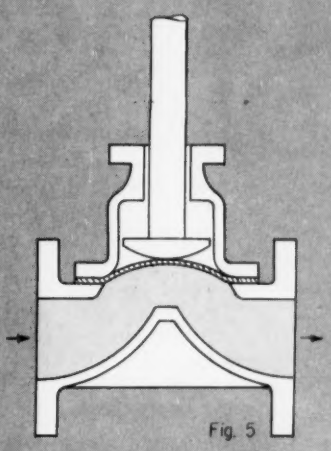


Fig. 5

Valves of this type combine three characteristics.

1. They do not need packing. Therefore, they can be used with toxic, flammable, explosive and valuable fluids. Also, these valves can be used with materials that solidify on contact with air and for vacuum service where inspiration of outside air must be prevented. The possibility of rupturing the diaphragm should not be overlooked. An emergency packing seal, as described for bellows seals, may be considered.

2. There is no valve trim except the seat diaphragm which consists of reinforced rubber, synthetic rubber or other pliable material. Hence, these valves can handle highly corrosive fluids.

3. There are no body pockets, recesses, corners, grooves and sharp changes in direction of flow. The smooth passages make these valves self-cleaning and allow their application to slurries and semi-solids. This last characteristic also produces a C_v factor about 60 to 70% higher than that of a double-seated valve of equal size.

The most important limitation of these valves are pressure and temperature. Generally, they can not be used for pressures above 150 psi. because the resulting force against the diaphragm becomes excessive.

Thrust forces on the valve stem are much larger than in conventional plug valves and also limit the pressure rating. Most synthetic diaphragm materials are not good for temperatures above 180 F. However, some are available for special applications at temperatures up to 400 F.

Butterfly Valves Handle Large Flows

Butterfly valves are particularly suited for controlling large flows, especially at low pressures. They are also used in pipelines carrying considerable amounts of suspended matter.

The butterfly valve, as shown in Fig. 6, is simply a large disk whose diameter is approximately equal to the inside diameter of the pipe section. This disk swings about a horizontal axis. In the horizontal position, the disk offers a minimum resistance to flow. In the vertical position, the disk shuts down the flow.

The disk is rotated by means of a shaft which extends through the pipe section and a lever which connects to the stem of a spring-and-diaphragm actuator. The illustrated butterfly valve is of light-duty construction without a stuffing box. This relatively inexpensive design is suitable for applications where some leakage at the shaft is not objectionable.

Valve characteristics of butterfly valves approach those of the equal percentage valve. (*Chem. Eng.*, Apr. 20, 1959, p. 175). Butterfly valves usually operate through about 60° of their total rotary movement. Any increase of the flow area beyond 60° is negligible.

The term, 100% travel, referred to a butterfly valve, means the angle through which the valve will operate. Butterfly valves produce practically no pressure drop when fully open. Hence, they are able to handle the same quantity of fluid that the pipeline is able to carry.

Comparatively high unbalanced forces, which the actuator has to overcome, exist across the disks of butterfly valves. The tendency of these forces is to close the valve. Since the disk is rotating, the forces act on it like on a lever. These forces must be expressed in torque as inch-pounds or foot-pounds.

Magnitude of these forces depends on the disk position and is proportional to the pressure drop across the valve. However, these forces also depend on the disk diameter. The forces vary as the cube of the disk diameter. For example: To close a 2-in. butterfly valve at a certain position with a given pressure drop requires a torque of 10 in.-lb. A 6-in. valve for the same conditions requires a torque of 270 in.-lb.

Butterfly Valves Handle Slurries Easily

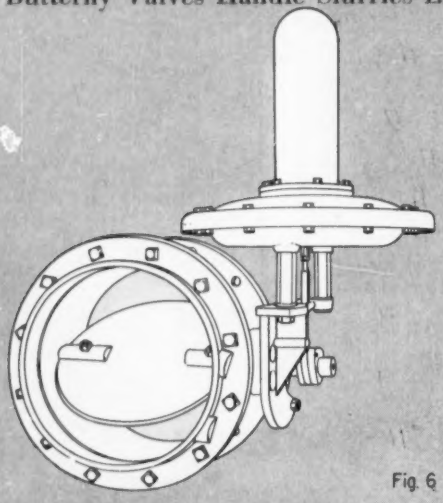


Fig. 6

Piston Operator Provides Large Stem Force

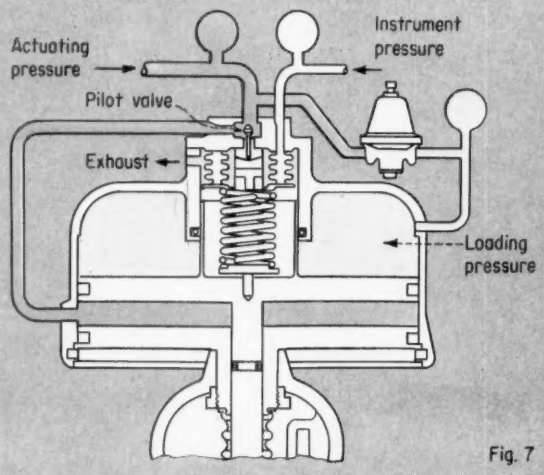


Fig. 7

Unbalanced forces push the disk against its bearings and friction results. This friction as well as the torque must be overcome by the actuator. In closing the valve, the actuator is assisted by the unbalanced forces; but on opening, the actuator is opposed by the friction plus the unbalanced forces. Under normal operating conditions, the torque required to position a 24-in. butterfly valve may amount to 6,000 ft.-lb.

Such large and changing torques have an influence on the control system to be chosen. Frequently, pneumatic systems are no longer adequate and hydraulic systems will be preferred.

Major advantages of the butterfly valve are its negligible pressure loss, its adaptability to materials with large amounts of suspended solids, and frequently in larger sizes, lower first cost as compared with plug and seat valves.

Piston Operated Valves

Thrust from the process fluid against the valve plug causes unbalanced forces. These unbalanced forces are comparatively large and a disadvantage in all valves, discussed thus far, except in the double-seated valve.

One of the most important advantages of the double-seated valve is that it can operate against relatively high pressure differentials because of well-balanced thrust forces across the valve plug. However, at increasing fluid velocities, the double-seated valve has certain disadvantages. These are mainly caused by the unavoidable cavities in the bodies of double-seated valves. The cavities produce excessive erosion and probably a lower C_v factor.

Some valve types were described which are suitable for higher velocities. None is double-seated. Hence, for the same pressure differential, valves suitable for high velocity flow require more power to move the valve plug.

The piston operated pneumatic valve provides this additional power. This increase is obtained by eliminating the valve spring and by using higher pneumatic pressures. Valve springs require considerable power for compression. Thus, little power is left to counterbalance the thrust forces. Furthermore, diaphragm-and-spring valves are generally limited to pneumatic pressures of 50 psi. Even where the controller output signal is amplified by a valve positioner, maximum pressure can not exceed 50 psi.

Piston operated pneumatic valves as shown in Fig. 7 are built for pressures up to 100 psi. These valves have two outside connections. One is to supply air pressure of 100 psi.; the other to receive the controller output signal. The space above the piston is loaded to a predetermined pressure by means of a pressure regulator connected to the air supply.

This regulator maintains an air cushion of constant pressure on top of the piston. Although the piston moves up and down in the cylinder, the pressure on top of the piston remains constant. The positioning mechanism is connected to the piston by means of a positioner spring. This spring is not equivalent to the valve spring in a diaphragm-and-spring actuator. The positioner spring provides a counterforce, proportional to the position of the piston, for the positioning mechanism.

Controller output signal is connected into the space between the inside area of the large bellows and the outside area of the sealing bellows. Motion of the bellows positions the stem of a pilot valve which controls the air pressure applied to the lower side of the piston. The pilot valve either admits air pressure from the supply or releases air to atmosphere through the exhaust port.

Provide Suitable Bypass for Control Valve Installation

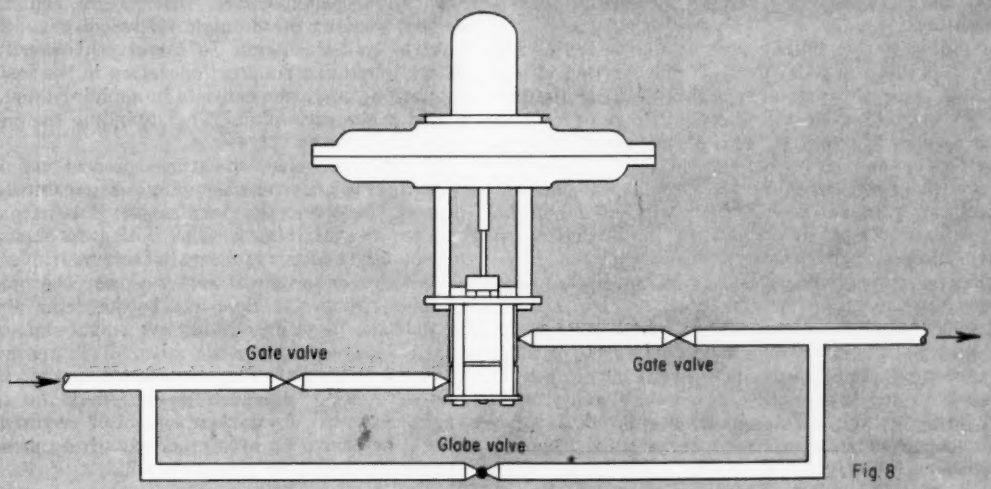


Fig. 8

Increase in pressure from the controller expands the bellows and causes the pilot valve to close the exhaust port and open the supply port. As the actuating pressure becomes greater than the loading pressure, the piston moves upward and compresses the positioner spring. The positioner spring applies an increasing force against the bellows assembly and thus counteracts the increased pressure signal from the controller. When the force of the spring equals the force produced by the controller output signal, the pilot valve maintains the piston in position. The pilot valve also provides an actuating pressure which balances the loading pressure plus any thrust forces that may be produced across the valve plug.

Since the pressure is automatically adjusted and maintained under the piston by the positioning mechanism, only a slight increase in the loading is necessary to push the piston through its entire stroke. The remaining air supply pressure is available to oppose the differential force across the valve. The piston is kept between the two pressures that actuate it, thus providing stability against any thrust forces pushing against the valve plug.

Valve Specification

In specifying a valve, it is necessary to have data on the following: (a) valve size; (b) valve characteristics; (c) single- or double-seated; (d) material of valve body; (e) type of pipe connections including exact dimensions; (f) material of valve trim; (g) valve action on failure; (h) type of packing; (i) special features such as cooling fins.

To determine these data, it is necessary to know

- Type of fluid through valve body.
- Upstream and downstream pressures in pipeline.
- Temperature of flowing fluid.
- Special gravity of fluid at flowing temperature.
- Maximum, minimum and normal flow rates.

Valve Installation

Before a valve is installed, its physical appearance should be checked to assure that it is in good condition. Also, its nameplate data should be checked to determine that plug type, characteristic, materials, pressure rating, and action on air failure correspond to the specifications.

Air piping to the control valve should be preferably ⅜-in. O.D. tubing or ¼-in. pipe. If the air line is less than 25-ft. long, one-quarter inch tubing is permissible.

It is desirable to install the control valve with a bypass as shown in Fig. 8. This arrangement permits removing the control valve from the line for maintenance without interrupting the process. In normal service, the gate valves are open while the manual globe valve is closed. If removal of the control valve becomes necessary, the gate valves are closed. Flow can then be manually controlled by means of the globe valve.

In bypass arrangements, valves which are either fully open or fully closed should be gate valves because this type produces the least pressure drop. However, the valve in the bypass line should be a globe valve which is better suited for manual regulation of flow. If a bypass is not used, some provision must be made for isolating the valve.

In general, the valve should be installed in horizontal piping. Actuator may either be above or below the valve. However, valve should not extend sidewards. This restriction is of particular importance with valves three inches and larger because the actuator has considerable weight and produces undue strain on the valve structure.

Practically all valve bodies have an arrow or "IN" and "OUT" marks which indicate the required direction of flow. Strict adherence to these directions in installing the valve is essential. Before installing the valve, it is good practice to blow out, with compressed air, the valve body and all connecting piping to remove dirt, scale and other foreign matter.

Diaphragm-and-spring valves are equipped with a spring tension nut to allow changing the tension of the spring. This tension is factory set but field adjustments are sometimes necessary. Compressing the valve spring means that more air pressure is required to start the valve.

If at a 9 psi. pressure signal a valve is 50% open, adjustment of spring tension is necessary to keep the valve 60% open under the same signal pressure. If the valve closes on air failure, then a relaxing of the spring tension is necessary to increase opening from 50 to 60% for the same signal pressure.

Packing nut on the stuffing box should be finger tight only. If the nut is too tight, it will cause binding of the stem and the control system will suffer because of the resulting dead zone. Most troubles are caused in the stuffing box and nearly always this is caused by faulty maintenance.

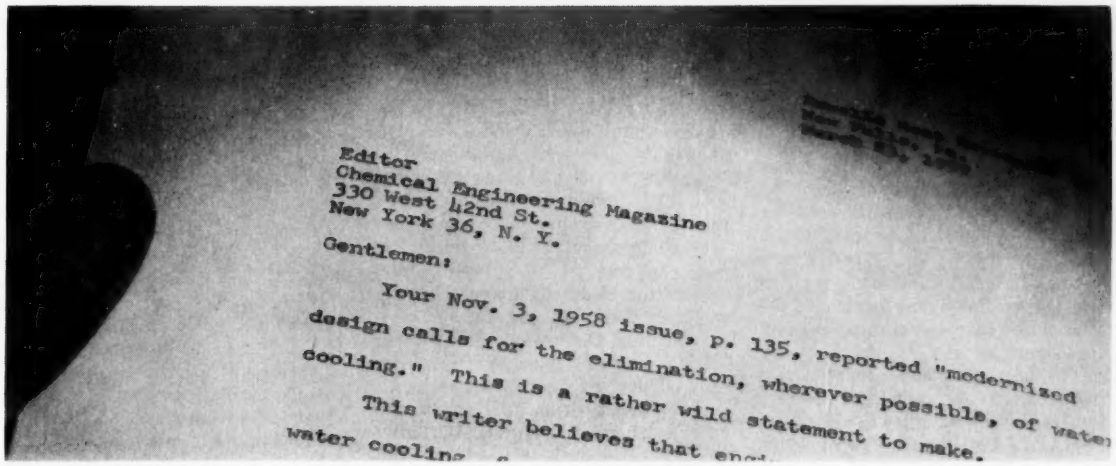
Leakage at the stem can not be stopped by tightening the packing nut with a wrench. Chances are the packing is either not suited or worn-out. Valve stem may also need cleaning. A periodic cleaning of the valve stem will prevent dirt and grit from being carried into the packing. If a lubricator is used, make sure that the proper lubricant has been supplied to valve packing.

It is unavoidable for the valve plug and seat to become worn in time. How long it takes depends entirely upon the severity of the service conditions. As plug and seat surfaces wear, valve characteristic will change. In the extreme case, a point may be reached where control of flow rate is no longer possible.

In single-seated valves, where tight shutoff is required, wearing of the material will gradually permit fluid to leak through. To correct this condition requires lapping, a frequent operation in the instrument shop. The operation consists in applying lapping compound to the valve plug. Then grinding the plug manually against the valve seat.

Double-port valves sometimes present the difficulty that the distance between plugs is greater than the distance between the two seats. Distance can be checked by examining whether both seats show lapping marks. If the fits are not satisfactory, it may be possible to raise the lower seat or lower the upper seat slightly. Where this can not be done, the plug must be made to fit by machining the surface of one plug.

Before re-assembling the valve, all sliding metal surfaces, bushings and stem, should be inspected for nicks and scratches. All such markes must be carefully smoothed over. All gaskets should be renewed. Bolts should be drawn up evenly and tightly to prevent any strains on the valve structure.


Editor
Chemical Engineering Magazine
330 West 42nd St.
New York 36, N. Y.

Gentlemen:

Your Nov. 3, 1958 issue, p. 135, reported "modernized design calls for the elimination, wherever possible, of water cooling." This is a rather wild statement to make.

This writer believes that engi-

This letter to your editor asserts water cooling is far from dead. New thinking on water as a cooling medium can lower costs and improve operations.

Better (Not Less) Water Cooling

THIS writer believes that engineers should closely examine water cooling, fan-blown air coolers, and natural convection air coolers. The "air-cooling band wagon" should be given a careful once over before one jumps aboard. The stirring strains of a circus band have been known to make the cautious heart beat violently and react foolishly. I believe a few good words are in order for water cooling.

Another Look at Water

For many years water has been our most economical means of removing nonrecoverable heat. Unfortunately, in many plants no progress in the use of water as a cooling medium has occurred in the last 20, 40 or should we say 50 years. Since water cooling has been with us for a long time, there has not been a determined effort to keep alert to new and improved approaches.

However, once the engineer is presented with the challenge of using air as a cooling medium, old standards are set aside and imagination in conjunction with technical know-how are used to the utmost.

It is time to apply an equivalent amount of skill, verve and know-how to examining the various alternatives connected with water cooling. Many new approaches lie before us. For example:

- Use sewage water for cooling.
- Increase water temperature range.
- Use less expensive materials of construction.
- Use more economical tube lengths.
- Increase pressure drop to cut fouling.
- Use less expensive exchanger designs.

Let's take a look at some of these cost-cutting possibilities.

Sewage for Cooling?

Process cooling can definitely be accomplished in many plants with waste and sewage waters, which have not been treated to make them potable. Water for industrial cooling does not have to comply with specifications intended for potable water. Only 1/10 of 1% of all industrial water is reclaimed sewage. Here exists a tremendous source of cooling water available to industry.

Boost Temperature Range

Amount of water cooling per gallon of water can be increased as the water temperature range is increased.

Many installations designed for water service only use a 20-degree water temperature rise. There are other plants using 35, 45 and 55 degrees of cooling.

One of the objections to the higher cooling ranges is that scaling occurs. Most water-treatment companies have been concerned with this problem for a long time. But many plants have not made full use of the latest knowledge in this field. An increase in water-treat-

ment costs may well double, triple, or possibly even quadruple the amount of cooling that can be obtained from any given quantity of water.

As the water temperature range is increased, cooling tower cost in dollars per gpm. is bound to decrease. High temperatures of operation might produce some adverse effects upon the California redwood commonly used in cooling towers. But experienced engineers in the field doubt this assertion. Chemical treatment of the woods, however, might be considered. Plastic cooling towers, or concrete cooling towers, or copper-alloy cooling towers may well become economical under revised conditions.

But can the deionized water produce 75 or 100 degrees of cooling economically?

There is a chemical plant of a major company located on one of our famous, or should we say infamous, rivers. For certain process fluids this plant cannot use steel, alloy steel, copper, copper alloy, or even the common stainless-steel tubing alloys in cooling water service. Only one of the more exotic stainless steels has been satisfactory. Could combined exchanger and cooling-water costs be any higher with the use of partially treated sewage water?

Consider Other Materials

Materials of construction should once again be examined. A wide variety of materials of construction are now being used in water-cooled heat exchangers. For example, channels can be made of carbon steel, cast steel, cast iron, steel with lead lining, steel with plastic lining, bronze castings, etc. Some plants report the favorable use of the least expensive material —ordinary carbon steel.

Greater use of cathodic protection with ordinary steels should also be considered.

Increase Tube Lengths

Heat exchanger costs decrease as tube lengths increase. More serious consideration should be given to standard tube lengths of 20 and 24 ft. These are now used in air coolers, and economic savings are also available for the use of longer lengths in water-cooled heat-exchanger equipment.

How to Cut Fouling

Increasing the pressure drop can reduce fouling and increase the heat transfer rate. D. Q. Kern, at the 1958 annual AIChE meeting, presented a paper, "A Theoretical Analysis of the Thermal Surface Fouling," in which his analysis indicates that exchangers can be designed to operate for periods as high as ten years without shutdowns for cleaning purposes. This paper presents the first theoretical approach to the use of liquid shearing to remove deposited dirt material. Thus, by increasing velocity and pressure drop, fouling in the unit is practically eliminated. Surface requirements, initial costs, and maintenance expense can all be reduced.*

Another point: water-cooled process plants should be designed with full consideration for the different inlet water temperatures available throughout the year.

Commonly plants are designed with an inlet water temperature equal to that expected during the worst of a summer season. As inlet cooling water temperatures decrease with cooler weather, many plants throttle down on the flow of water. As velocities decrease, fouling increases. As a result more water must then be admitted to these units. It would be desirable to arrange for operation by seasons with certain waters diverted to flow in series as the temperature of the inlet water falls. High velocities would be maintained at all times and fouling kept to a minimum.

Use Inexpensive Construction

Many chemical plants operate satisfactorily with fixed-tubesheet heat exchangers. Nevertheless many others make use of the far more expensive internal floating-head construction. The latter is the choice of refineries where excessive surface fouling is regularly expected. Many chemical plants do not encounter this phenomenon.

With high velocities and the elimination of tubeside fouling, as discussed above, U-tube construction is definitely practical. Even with some tubeside fouling, U-tube construction is feasible when the U bends are properly designed to make use of suitable tube cleaners.

With reduction of fouling, the need for removable bundles, which can be readily cleaned, disappears. Fixed tubesheet units should come into greater use.

Use Air and Water

When over-all process conditions dictate that process fluids at temperatures of 300 F. must be cooled by throwing the heat away we suggest that natural convection cooling by air to an approach of 70 to 100 degrees is practical. Low cost tubes with widely spaced square fins attached by a simple process can be used. Such tubing is available and is used in home and industrial air heating installations. Without fan induced vibration these cheap fin tubes will function well. Water cooling can be used for the last 50 to 150 degrees of cooling.

Adherents of fan-blown air coolers point to the tremendous amount of cooling that these units can accomplish in the event of power failure. But why use power at all? Would it not be feasible to air cool by natural convection when the process fluid is at temperatures of 500, 300, and even 250 F.? All we would need would be finned surfaces, installed up in the air to accomplish this cooling. Then fan-blown air or a water cooler could be used to bring the process fluid down to the required outlet temperature.

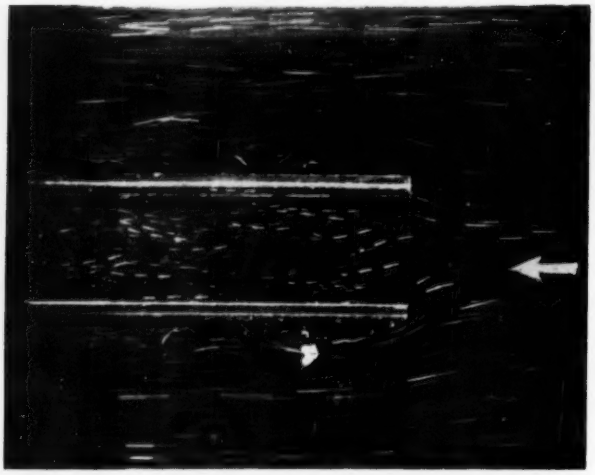
The recent 1958 AIChE symposium on air cooling and several articles in the technical press have contributed to an increased interest in air cooling. Every one of the articles has a biased point-of-view.

There is no doubt that considerable engineering skill has been applied in developing approaches which justify use of air as a cooling medium. But this is not the final answer to the question of air vs. water cooling.

Engineers at adjacent plants of different chemical companies have considered the problem and each group arrived at different conclusions. It would be desirable to have articles published by companies which have investigated the problem and have chosen to continue to use water cooling.

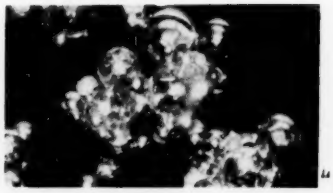
(Name Withheld)

* It is possible that the velocities required may be sufficiently high to produce erosion of the tubes. In this event it may be necessary to substitute cupronickel or stainless steel tubes in place of the more conventional copper alloys now commonly used in water-cooled installations.



Fluorescent Particles Photographed With UV

Exposure of 1/25 sec. with flow velocity of 6 ft./sec. shows shorter streaks, hence lower velocity, within the tube. (Photo by A. J. Yerman, General Eng'g. Lab.)



Spray Dryer Makes Spheres

They can be made in narrow range of size and density.

Better Way to Trace Liquid Flow Patterns

Suspended fluorescent particles lighted with UV gives fine photos. You can make your own of any density by methods given here.

★ **Winner of the March Contest by**

Merton Allen

Chemical Engineer, General Engineering Laboratory
General Electric Co., Schenectady, N. Y.

In designing equipment for fluid flow, one often has to examine the flow pattern in the equipment by visual means. I have developed an improved method which overcomes the disadvantages of visual methods used in the past.

Visual study of fluid flow patterns goes back to Reynolds' original experiments. Usual methods employ an ink or dye solution which is injected into the fluid upstream of the area where the investigations are to be made. Often, with extreme turbulence, the colored material blends with the fluid body to give a completely colored fluid, rather than the desired wisps or strings of color. Then, test results become meaningless from a quantitative standpoint.

My method makes use of small colored particles—100 to 500 microns in size—which are suspended in the fluid to be observed.

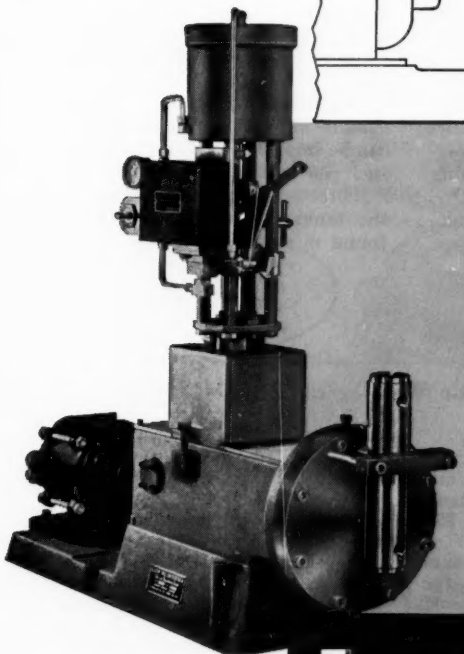
The particles can be colored as desired. In fact, if more than one fluid is to be observed, or more than one pattern, then more than one color can be used. Examples might be in agitators or pipeline reactors.

The particles must, of course, be of suitable density and unaffected by the fluids they contact. One of the best ways to color them is to use fluorescent pigments which can be excited by ultraviolet light and will then give off colored visible light. When illuminated with ultraviolet in a dark room, the particles will glow like burning embers and can easily be seen.

If the ultraviolet source is strong enough, the particles can be photographed in black-and-white or color film with a conventional camera and a timed exposure.

This results in streaks of light depicting the flow patterns. The length of the streaks, of course,

The "INSIDE STORY" of Auto-Pneumatic PULSAFEEDER CONTROLLED-VOLUME PUMPING



In many industrial processes, liquids must be metered in relation to some changing process condition. It can be a change in flow or pH, temperature or pressure. Instruments can sense such a change and transmit an air signal descriptive of that change. The auto-pneumatic control mounted on the Pulsafeeder pump receives and interprets this signal and automatically adjusts pump to meet the process variable. This is accomplished by a positioning device on the auto-pneumatic control that loads or unloads the air cylinder, accurately moving the air piston to position the connecting rod (1) in relation to the axis (2). This determines the stroke length of the pump—a longer stroke increases pump output; a shorter stroke reduces output. Instrument air pressure over a range of 3-15 psig. controls Pulsafeeder output from 0-100% of capacity. Ratio adjustment is available in all models.

WRITE FOR BULLETIN 440 *with typical applications, flow charts, description and specifications of both* MANUALLY CONTROLLED *and* AUTO-PNEUMATIC *models of various capacities and constructions. Inquiry Data Sheet included from which we can make specific engineering recommendation for your processing requirement. Write Lapp Insulator Co., Inc., Process Equipment Div., 3608 Poplar St., Le Roy, N. Y.*

Lapp

gives a quantitative measure of velocity in relation to exposure time, while their angle gives a measure of direction. Extra accuracy results if the streaks are photographed in more than one plane.

The main problem in using the colored particles is to secure the right density. The particle density must be quite close to that of the liquid to minimize settling out. How close the density match must be depends on the desired accuracy of results. A closer match is needed for fluids in laminar flow than where there is turbulence.

If the fluid density is greater than 0.9 gram/cc., one can find many solid materials which will give a close density match. Certain resins can be used, or various resins blended to give almost any density between about 0.9 and 1.8 gram/cc.

For densities above about 1.8, the resin can be filled with solid matter to increase its specific gravity. The pigment can be incorporated into the resin in the melted form, the melt solidified and ground to size.

Specially prepared particles are needed for fluids of density less than about 0.9 grams/cc. There are two good methods for making such particles in the range from 0.2 to 0.9 gram/cc.

One method starts with an already available product—expansible plastic beads which are made by a number of commercial sources. These are spherical or nearly so and contain a "blowing compound." When such beads are heated they soften and the blowing compound volatilizes and expands so that the particles increase in size and decrease in density.

Particles of this type are composed of minute unicells of gas-filled plastic—a foamed structure. By this method you can go as low as 0.2 gram/cc. in density.

A good way to conduct this expansion is to carry the beads on a belt beneath infrared lamps.

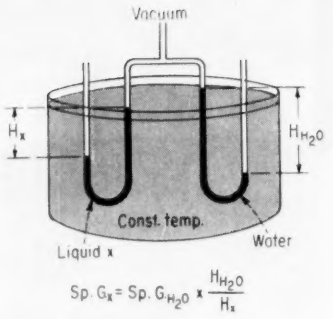
When you buy them, such beads are of random size, with random quantities of blowing compound. Consequently, you get a distribution of particle sizes and densities by expanding them. After coloring, they can be sized and then density-separated by the method described in the author's Design Notebook article, p. 182, Dec. 15, 1958.

This method involves suspending the particles in a liquid of the desired density and then making a separation in a disk-bowl or other suitable type of continuous centrifugal.

Beads may be left white or colored by either chemical or physical means. The surface can be coated with an adhesive and powdered pigment brushed on; or the pigment can be dispersed in a chemical which will react with the bead surface so as to trap pigment by chemical fixation.

Another good way to make low-density beads is by spray drying. The plastic can be dissolved in a low-boiling organic solvent, with the color incorporated directly into the resulting liquid. Particles made in our laboratory spray dryer are shown on p. 148. They are hollow resin spheres and can be produced in much narrower ranges of size and density than by the expanding bead process. The same density-separation method is applicable.

With the spray-dryer method I've produced hollow spheres from about 20 common plastics such as polystyrene, polyvinyl chloride, cumarone indene, polyvinyl alcohol and butyral, using such solvents as methyl ethyl ketone, acetone, ether and chlorinated solvents.



Find Liquid Density Versus Water

Richard R. Palumbo
Development Engineer, Columbia-Southern Chemical Corp.
Barberton, Ohio

Illustrated above is a simple way of finding liquid specific gravities in the pilot plant where analytical balances and pycnometers may not be available.

Water and the unknown liquid are put into manometers and the heads *H* measured for the same temperature and same vacuum. Any vacuum-producing device is satisfactory. For greatest accuracy submerge both manometers in a constant-temperature bath.

Reading accuracy of 0.1 in. usually suffices but, if need be, can be improved in various ways, such as with an inclined-tube manometer. Gravity of water at the temperature of use can be found in many handbooks.

NEXT ISSUE: Watch for Winner of April Contest

★ How Readers Can Win

$50 Prize for a Good Idea—Until further notice the Editors of *Chemical Engineering* will award $50 each four weeks to the author of the best short article received during that period and accepted for Plant or Process Design Notebook.

Each period's winner will be announced in the second following issue and published in the third or fourth following issue.

$100 Annual Prize—At the end of each year the period winners will be rejudged and the year's best awarded an additional $100 prize.

How to Enter Contest—Any reader (except a McGraw-Hill employee) may submit as many contest entries as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable non-winning articles will be published at space rates ($10 minimum).

Articles should interest chemical engineers in development, design or production. They may deal with useful methods, data, calculations. Address Plant & Process Design Notebooks, *Chemical Engineering*, 330 W. 42 St., New York 36, N. Y.

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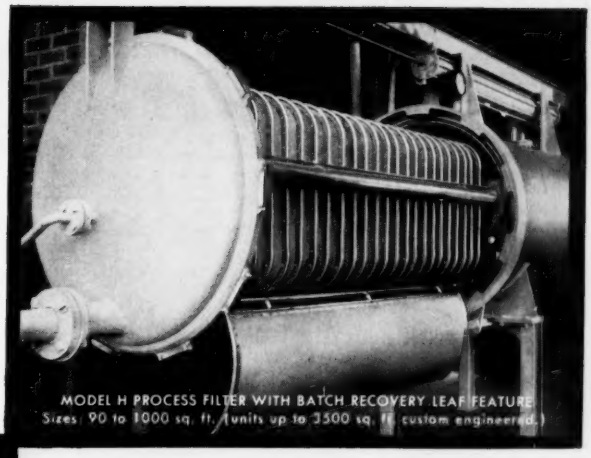
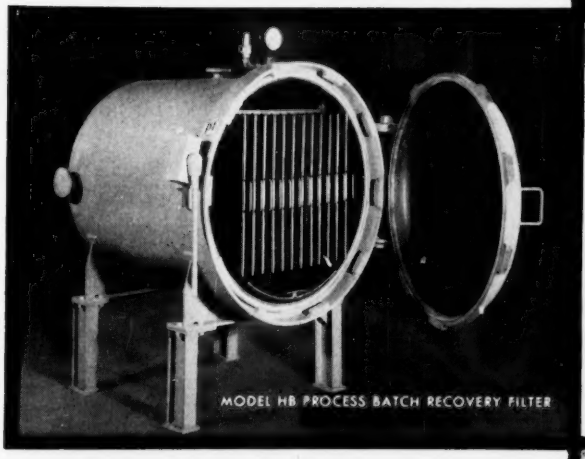
FASTER...MORE EFFICIENTLY...



MODEL H PROCESS FILTER WITH BATCH RECOVERY LEAF FEATURE
Sizes: 90 to 1000 sq. ft. (units up to 3500 sq. ft. custom engineered.)



MODEL HB PROCESS BATCH RECOVERY FILTER

. . . *example*

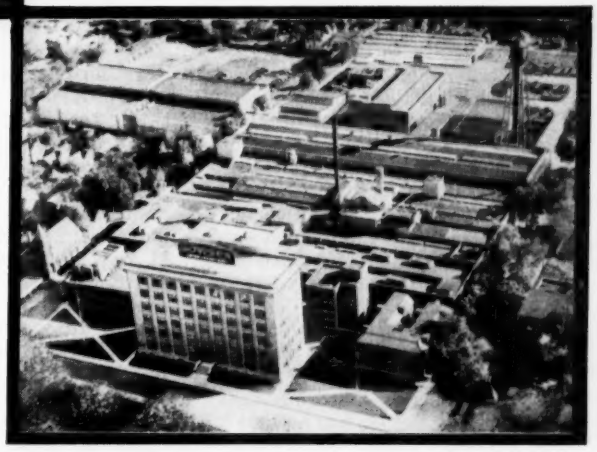
batch filter

A 40 sq. ft. Process Model HB Filter clocked 1¾ hrs. in filtering a 2500 gallon batch—actually doing the job in less time than a 160 sq. ft. plate and frame filter. Residue remaining in the tank at the end of the regular filtration cycle was blown through the recovery leaf in five minutes.

Cake discharge took 8 minutes.

dependability counts

PROCESS FILTERS DIVISION laboratory and plant are now part of the original Bowser, Inc. facilities pictured at right. You can rely on PROCESS FILTERS' product and service!



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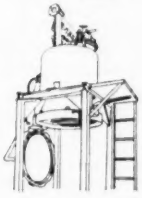
Liquid Control Specialists Since 1885 . . .



VERTICAL LEAF FILTERS VERTICAL BATCH FILTERS

Process Filters makes available pilot plant test filters which determine answers to new or unusual filtration problems.

MORE FACTS?

Write for one or all data folders:

"Batch Recovery";

"High Solids Removal"; or

"Polish Filter".

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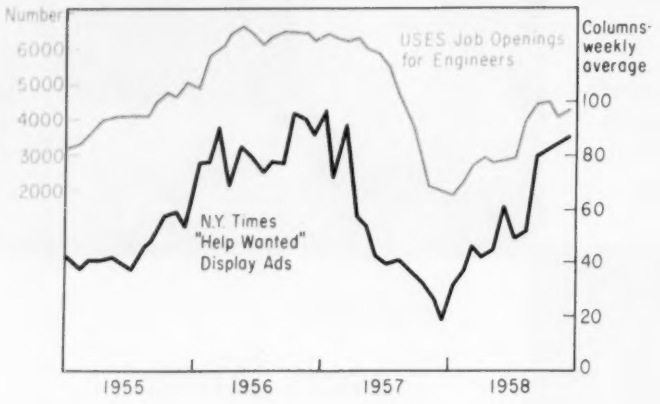

Job Signals Point Upward

Employers chopped away at deadwood last year. Now, things are looking up.

Readers of this department may have noticed the absence of one of our regular features.

If it had appeared it would have borne the title, "Straight Facts on the 1959 Job Outlook." Last report we made on employment conditions for engineers appeared in our Mid-November 1957 issue. It predicted what the outlook was for 1958.

Then came the recession.

By the fall of 1958 Midland, Mich., for example, had become an engineering hardship area; Wilmington, Del., had become an area with a labor surplus; and throughout the U. S. employers of engineers were going through agonizing reappraisals of their manpower requirements.

Employment news, late in 1958, seemed to be all bad news. Even the real "pros" in this business prefer not to report only bad news. So, we took the easy way out and put off to tomorrow what should have been done yesterday.

We're glad we waited, because a few early signs of better times are creeping over the horizon. Bill Chartener of McGraw-Hill's Dept. of Economics suggests that two of the most reliable predictors of the short-run demand for engineers are:

• The report of job openings prepared by the Bureau of Employment Security, U. S. Dept. of Labor. (Recently, BES has added a new series of bimonthly reports on "Current Labor Market Conditions for Engineering, Scientific and Technical Personnel.") Over the five years, 1954-1958, engineering jobs have accounted for about 20% of all openings listed. Note that the plotted data from these reports (shown in color above) show an upward turn predicting more jobs in 1959.

• Help-wanted display advertising in the New York Times—and especially its Sunday editions—has gained a reputation as a gage of demand for technical manpower. As you can see from the chart above, things are looking up.

To keep pace with the Times, the New York Herald Tribune has continued publication of "Engineers' News Supplement." This special Sunday section appears monthly and brings together engineering recruitment ads and specially written editorial features. The Trib reports that ad volume in this supplement has been picking up ever since last October.

Get a Job the Easy Way

Perhaps the most encouraging sign of good times ahead is the appearance of two new recruiting devices. They are "Career for the Experienced Engineer and Scientist," published by Careers, Inc., of New York City and "Engineers' Job Directory," put out by Decision/Inc. of Cincinnati.

Both of these offer the employed engineer the opportunity of "circling a reader service postcard" to pick a new job that is to his particular liking. Careers, Inc., will even mail you a "Monthly Job Locator," which keeps you up to the minute on the latest tips from the recruiting market.

Once you have registered with the sponsors of these two devices, you can have them mail your resume to literally hundreds of prospective engineer-hungry employers with almost as little effort as is needed to check off a number on a reader service card in *Chemical Engineering*.

There are, of course, nominal charges for typing, printing and mailing your resume. However, it's rather obvious that the main source of income for these publications is supplied by the prospective employers.

Of course, this may all be a part of our over-all defense expenditures. But for engineering as a whole, job signals are pointing upward in 1959.

More YOU & YOUR JOB . . .
Please turn to p. 154.

You should know more about the new ACF non-lubricated Ball Valve

Now, while you're thinking about it, ask your secretary to have us send you Catalog 1000.

This catalog will give you a full description of the latest product of W-K-M's creative engineering—the ACF non-lubricated Ball Valve.

This new valve was service-tested for 3½ years before it was offered to buyers. Service-*tested* and service-*proved*: in the entire 3½ years, every user reported completely satisfactory results.

It's a great valve, this new one: versatile, rugged, efficient, easy to maintain on those rare occasions when maintenance becomes necessary, a valve you can specify with complete confidence.

So send for Catalog 1000—you should know more about this *new* valve.

Product of W-K-M's *Creative Engineering*

This cut-away picture shows you why this new valve performs so dependably, lasts so long, and is so economical to maintain.

Note the full, round conduit through body and ball that assures full flow through the valve—without turbulence, and with no more pressure drop than through an equivalent length of pipe.

Note the way the ball is suspended between Teflon seats under compression, assuring leakproof service at rated working pressures, or under vacuum, indefinitely.

Note the way actual seating surfaces are sealed away and protected from any abrasive action of the lading flow in either open or closed position.

Available in carbon steel (ASA 150 lb., 300 lb.), and semi-steel (200 lb., 400 lb.). Sizes range from ½" through 6". See Catalog 1000 for full listing of sizes and pressures.

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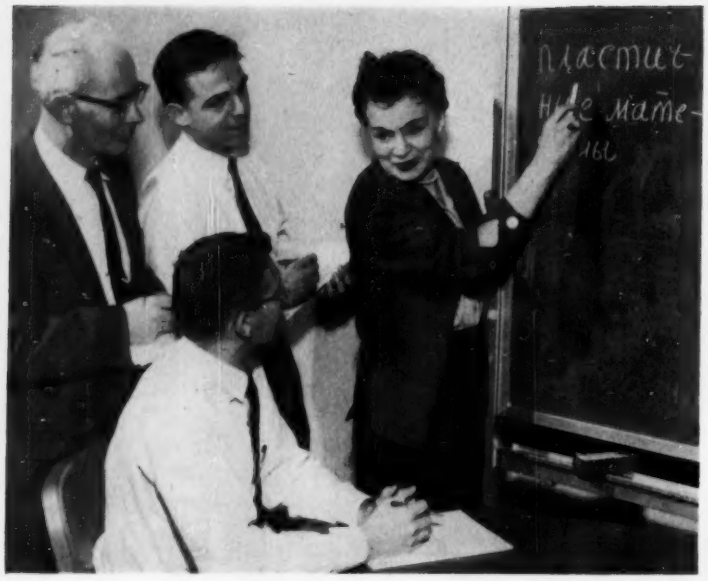

Rush on Russian Know-How

Process companies stress language skills, instead of translation.

This week the men in the photo above will gather after working hours at the B. F. Goodrich Co. research center in Brecksville, Ohio, for additional lectures in technical Russian translation.

Their goal: mastery of technical Russian in seven months.

John F. Anderson, Harold Tucker (standing left and right, respectively) and Robert E. Frost (seated) are but three of 31 research engineers and scientists who hope to be able to read Russian technical journals in their original form soon. The charming lady with chalk in hand is Prof. Thais Lindstrom of Western Reserve University.

Dr. Lindstrom, who speaks five languages, learned Russian the hard way. She was born there.

Improved language skills of Goodrich researchers will enable the company to save time and expense. Language specialists now ask up to $20/page to translate Russian technical papers.

Meanwhile, back in New Jersey, employees of Union Carbide Plastics Co., Ciba Pharmaceutical Products, Inc., and Merck & Co. will be attending Russian language classes sponsored by their companies and provided as part of the off-campus program of Union Junior College, Cranford, N. J.

Union Carbide, for example, reserves its auditorium in Bound Book each Wednesday for the 90-min. class sessions. On June 10—after 15 weeks of study—the first group of Union Carbide researchers will face final examination by instructor Savel Kendall. If Kendall passes them, the company will pick up half the bill as part of its educational refund program.

72 Hours to Russian

This summer those engineers in the New York metropolitan area who feel that they must keep abreast of current Russian publications, can take advantage of two new courses at the Polytechnic Institute of Brooklyn.

"Russian for Research I," is an intensive, six-week course which will meet Tuesdays and Thursdays from 6:30 to 9:30 P. M. It stresses syntax, grammar and technical idioms. The second six-week course meets the same hours and includes readings from technical journals covering several fields of science and engineering.

Brooklyn Poly believes that there is an increasing demand for persons with dual competence in some scientific area and in the Russian language. These two courses are designed to meet this long-range need.

Statistical verification of the need can be found in a report published by the National Science Foundation late last year, NSF-58-31, "Foreign Language Knowledge of American Scientists, 1954-55." Only about 1 in 50 of those scientists reporting language ability had knowledge of Russian. German was the language reported most often and French next, obviously a reflection of graduate degree requirements.

Chemists and chemical engineers show the most language proficiency among all scientists and engineers. However, only about 1,500 chemical registrants claimed competency in the Balto-Slavic languages, while more than 20,000 have been trained in Germanic languages.

In the months ahead you will be hearing about government-financed plans—in cooperation with certain engineering societies—to build up gigantic Russian translation programs. Perhaps this a a sound frontal attack on the problem.

However, suppose we could train those 20,000 chemists and chemical engineers who already know Germanic languages to read Russian in 12 weeks, in 15 sessions each 90-min. long, or even in as long as seven minutes. Would this be a better program for the long haul?

How Blaw-Knox cuts your power piping costs

121,000 square feet of space at your service. Power piping facilities at Pittsburgh include 56,000 square feet of plant area and an additional 65,000 square feet for exterior storage. An additional new plant is located on a 15-acre site in Jackson, Mississippi.

Your job is under the personal supervision of an experienced engineer, who follows your project from beginning to end. Your piping is handled with the most modern equipment for welding, heat treating, and bending. Fabricating techniques, proven by rigid testing, are used.

New product development. Blaw-Knox developed an enclosed type of functional spring hanger as part of their complete line of hangers for supporting any piping system. Here a group of hangers individually designed for a project is factory checked to assure fast field erection.

Stress calculation cut from months to a day . . . with pace-setting engineering. An exclusive Blaw-Knox method uses an electronic computer for automatic computation with no limitation on the complexity of system. Full accuracy, with tremendous savings in time and cost. Write for details.

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Cavitation . . .
. . . one of the most vicious demons of pump destruction, was the nemesis that gnawed this pump casing to worthlessness. Cause and cure of cavitation as well as corrosion are featured in this issue. Coming: A second moneysaving installment with practical tips on erosion, packings and bearings.

Longer Life for Centrifugal Pumps

. . . Cause and Cure of Cavitation and Corrosion

NEAL B. HEAPS, Mission Mfg. Co., Houston, Tex.

OF ALL the equipment you select, the centrifugal pump is one of the most vital—the heart of the plant—one of the few pieces of equipment for which you frequently install 100% spares. Properly selecting this equipment is the most important factor in determining the service life a centrifugal pump gives.

Centrifugal pumps are generally designed to do some specific job. Short service life then, in most cases, means the equipment is being put to some sort of misuse: mechanical, hydraulic, chemical or maybe even electrical.

One reason you can buy 100% spares is because the first cost of all pumps for a chemical plant represents a relatively small amount. But, an equally important reason is that centrifugal pumps must run 100% of the time to keep a plant on stream. Removing a pump prematurely from service causes lost production and increases your operating cost, so you should consider the burden operating processes place on pump performance.

This article outlines some stringent operating conditions that shorten the life of a cen-

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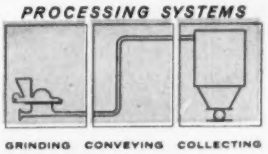

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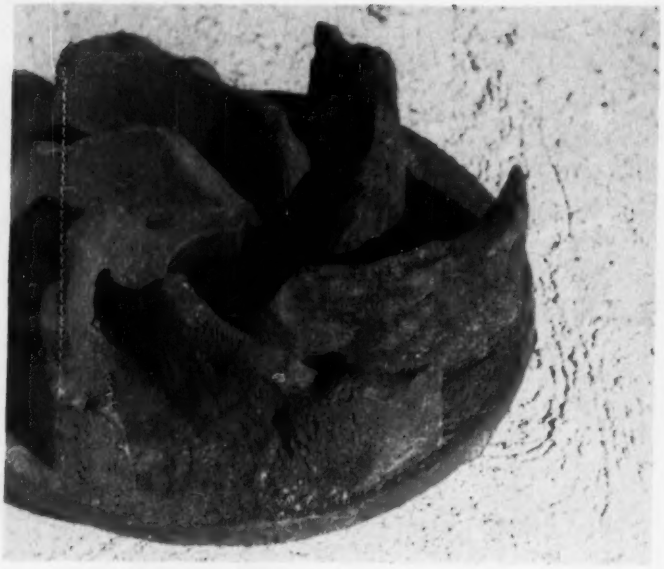


Corrosion . . .

. . . first etches the entire surface uniformly. This disturbs fluid flow and causes large irregularities as in the impeller above. Control corrosion here the same way you do in other equipment.

trifugal pump. It also describes the physical effect of each on the pump. Attribute the same type of pump appearance in your equipment to the same cause.

A centrifugal pump consists merely of an impeller and a means to rotate it so that fluid is flung—scientifically, of course, and under controlled conditions. But a pump that flings fluid as intended is doing all the designer and user can possibly expect.

The word "fling" is used advisedly: the impeller only imparts controlled velocity to the fluid present within the casing. This fluid reaches the casing through some other means, usually as a result of the familiar principle, "nature abhors a vacuum."

Failure to recognize this fundamental law is the one largest single cause for reduced pump life since it leads to that constant bugaboo: cavitation.

Cavitation Cuts Output and Life

Cavitation is a hydraulic phenomenon occurring at extreme low-pressure areas. Pockets or cavities of vapor (vapor of liquid in the pump) are formed. These collapse when they pass into an area of greater pressure causing the characteristic rattling noise and damaging shock loads that reach several thousand pounds in local areas. Shock loads of this size literally knock out pieces of the metal as shown in our illustration (p. 156).

Pumps operating under conditions producing cavitation display sharp-edged pitting (as differentiated from gouging or erosive wear) at the point of lowest pressure: the eye of the impeller, the suction inlet of the casing and the back side or trailing edges of the impeller vanes.

Excessive cavitation also reduces pump output and efficiency and, through undue vibration, causes packing and bearing failures.

To eliminate cavitation, increase the pressure within the pump by:

- Increasing suction pressure.
- Increasing suction-pipe diameter.
- Decreasing suction-pipe length.
- Reducing flow by throttling discharge (not suction).

You'll recognize that these factors, so simply stated, are the basis of all calculations for the net positive suction head (NPSH). It is a term widely misinterpreted, most frequently and unnecessarily regarded as complicated and the perennially favorite subject for complete articles such as this one.

Briefly stated, NPSH comes in two forms:

Available—For the pump user, where a specific pump application provides a NPSH available.

Required—For the pump designer, who contours the innards of his pump to minimize entrance losses, etc. He ends up with a NPSH required to force the fluid into the rotating vanes so they can commence pumping.

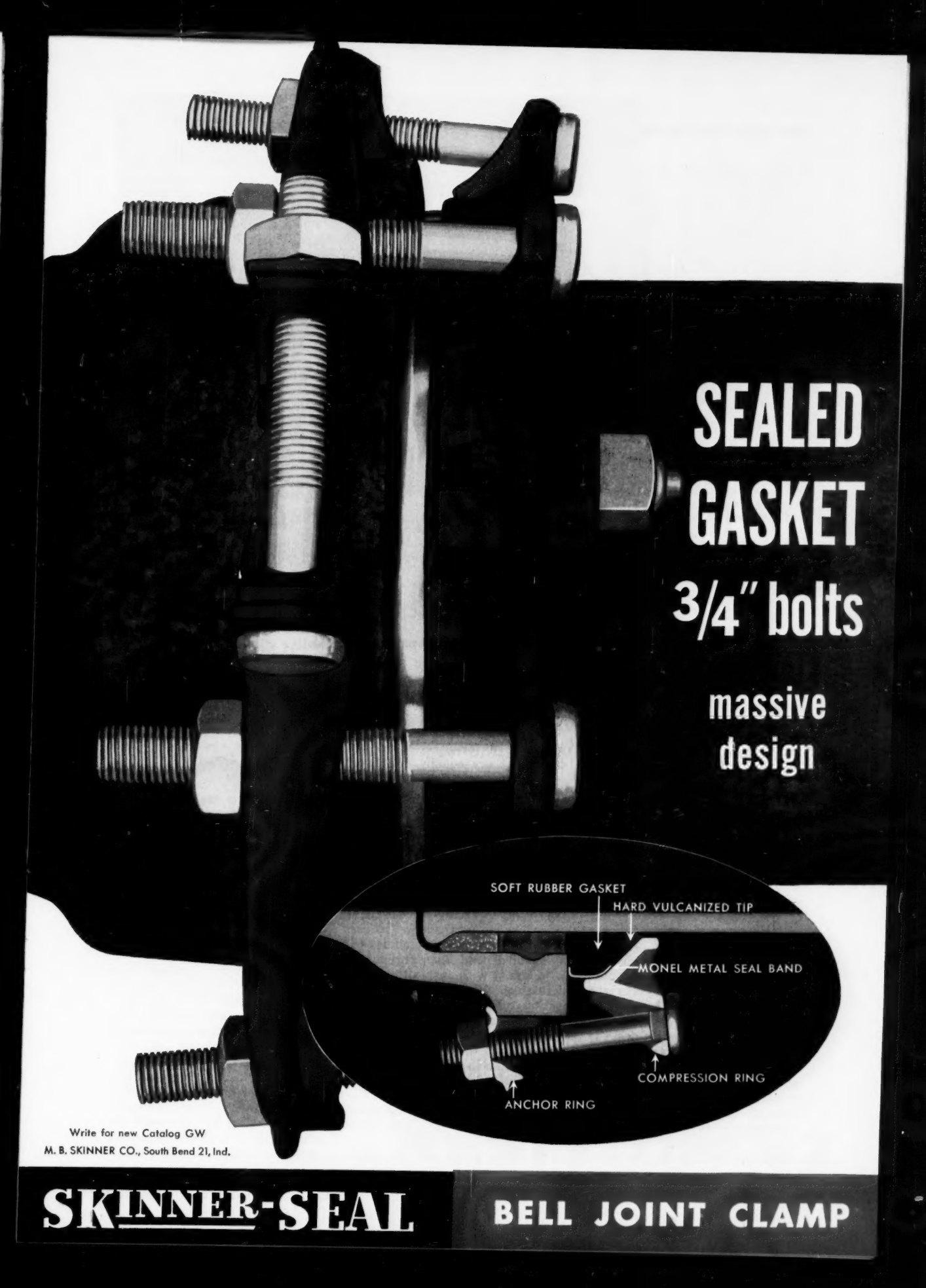
The only part of the available pressure that's usable pressure is that amount above the vapor pressure of the liquid. Therefore, you improve suction conditions by decreasing the vapor pressure of the fluid.

Cavitation, then, occurs at the entrance to a pump where the NPSH available isn't as much as the NPSH required; and the cures listed above will increase the NPSH available.

Of course, you can reduce the NPSH required, but obviously, this is a chore for the pump designer since it involves properly chosen vane entrance angles, leading edges of vanes, eye areas and fluid passage shapes. In fact, all of these factors have been attended to properly for the range of applications the pump was originally designed. Difficulties in this regard indicate you are misapplying the pump.

Though pumps are most commonly affected at the impeller eye, any point where the fluid flow pattern within the pump causes extremely low pressure can show the ravages of cavitation: Primarily behind vane trailing edges or at any discontinuity where a cavity forms because the liquid particles can't follow pump contours. The cure is to increase fluid pressure at the point of cavitation by:

- Reducing discharge flow rate.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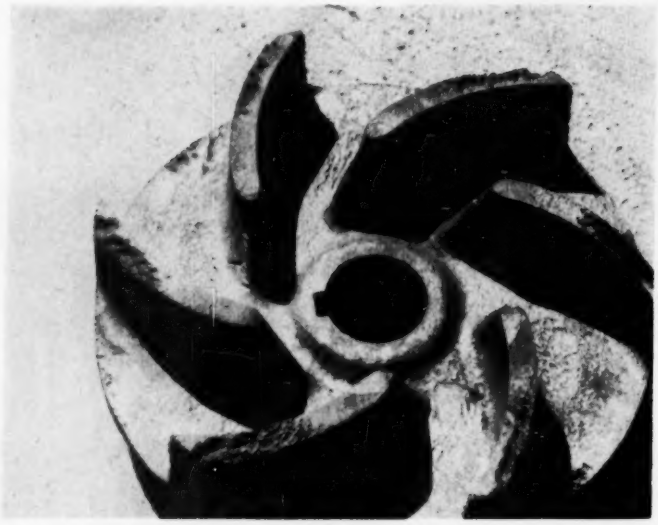

Cavitation-Corrosion . . .

. . . comes from the combined effect of high velocity, lowered pressure and corrosiveness of the fluid. Result is pitting to various depths and sharp edges—especially at the points of highest velocity.

• Reducing impeller speed, making it easier for the fluid to stay behind the vanes.

• Increasing the suction pressure.

Cavitation problems should be avoided on the process designer's layout board. First, by providing ample NPSH. Second, by selecting a pump designed for these conditions.

Corrosion Must Be Controlled

Of equal importance to cavitation, corrosion occurs more frequently and is better understood.

Characterized by an etched appearance, corrosion is basically the result of improperly selecting materials for the wetted parts of the pump.

Appearance is modified by the washing action of the fluid, particularly if abrasive solids are present. Generally, where corrosion is the primary cause for removing a pump from service, the typical corroded surface is evident as shown in the photograph on the previous page: uniform removal of metal; pebbled or grained finish, with ridges or grooves in a crystal-like pattern; pitting of uniform depth and uniformly distributed over the entire surface of the pump interior.

Microscopically, the surface is etched. The specific surface you observe depends on the particular metal and fluid.

Normal controls to reduce corrosion used for other types of equipment are equally effective, or ineffective, for pumps—cathodic protection, aeration or nonaeration, passivation, corrosion inhibitors, coating—but basically, the cure is one of proper material selection rather than pump selection.

Because of the high flow-velocities in most process pumps, corrosion is usually accelerated. This is so particularly where corrosion-resistant properties of a metal depend upon formation of a film as with austenitic stainless steels, because the scouring action removes the film.

Therefore, it's especially important you test corrosion samples in a flowing stream rather than in a beaker and that the fluid is in the same state as prevailing in the pump from the standpoint of agitation, temperature, solids content, pH, aeration, etc.

Galvanic action can take place within a pump. For example, lead pipes must not be connected to pumps made of certain grades of stainless steel.

When corrosion is more pronounced at points of low pressure, or cavitation points, it's likely a dissolved gas is coming out of solution and causing accelerated corrosion. Oilfield salt water, for example, may contain hydrogen sulfide in solution, which is only too anxious to cause trouble if released by lower fluid pressure.

As a tank shows greatest corrosion at the waterline, where the surface is alternately dunked and aired, so can cavitation effect pump corrosion as shown in the photograph (left). Even cathodic protection isn't wholly effective where the metal isn't continually submerged. Eliminating low-pressure spots is an important corrosion abatement measure in such instances and the factors to consider are those enumerated for cavitation.

Look for the Second Part

This is the first of two articles dealing with centrifugal pumps, why they fail and failure prevention. Second article covers: erosion, packings and bearings.

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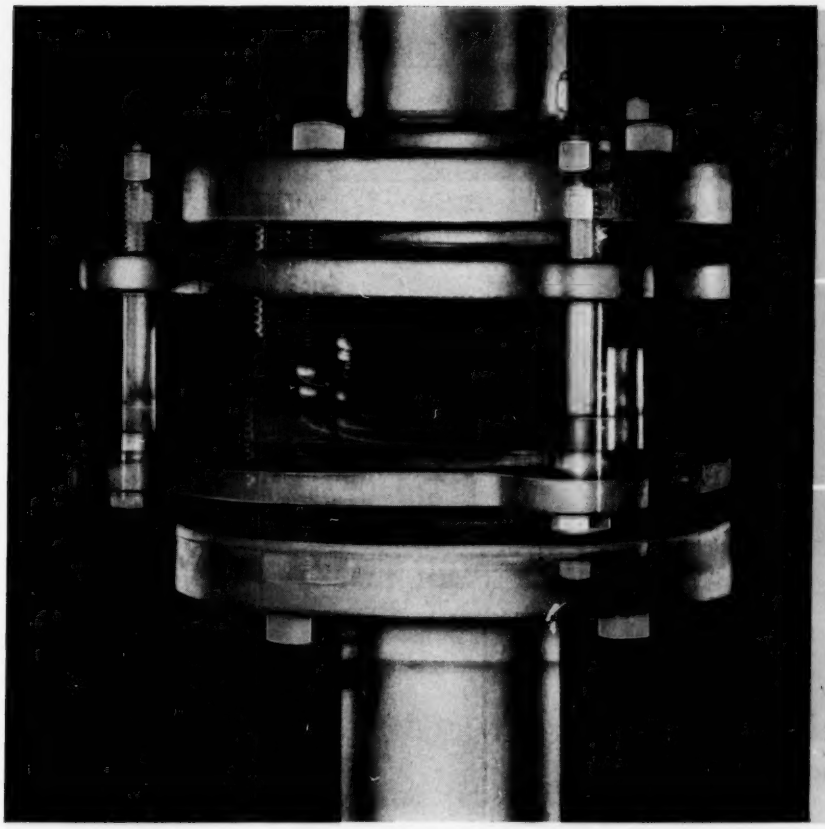
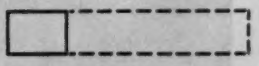


MOLDED DESIGN

rounded interior convolutions, extra thickness at stress points

HIGH TENSILE STRENGTH



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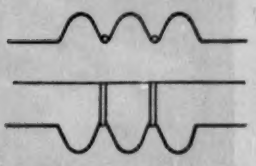
METAL REINFORCING RINGS



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Major industrial product company: Displaced one end of a special Fluoroflex-T bellows ¾-inch from its axis, rotated it around axis at 1,000 rpm. After *20 million cycles,* with still no sign of deterioration, test discontinued.

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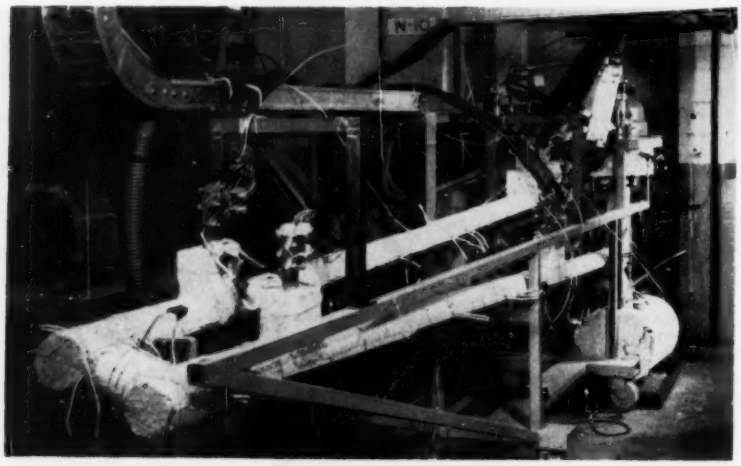


Extensive tests prove good resistance to . . .

- Corrosion from fluoride salts.
- Oxidation in air.
- Elevated temperatures as . . .

New Alloy N Joins Hastelloy Family

F. S. BADGER, Haynes Stellite Co., Div. Union Carbide Corp., Kokomo, Ind.

For several years, engineers at Oak Ridge National Laboratories have been screening alloys in a search for a container material for fused fluorides containing uranium.

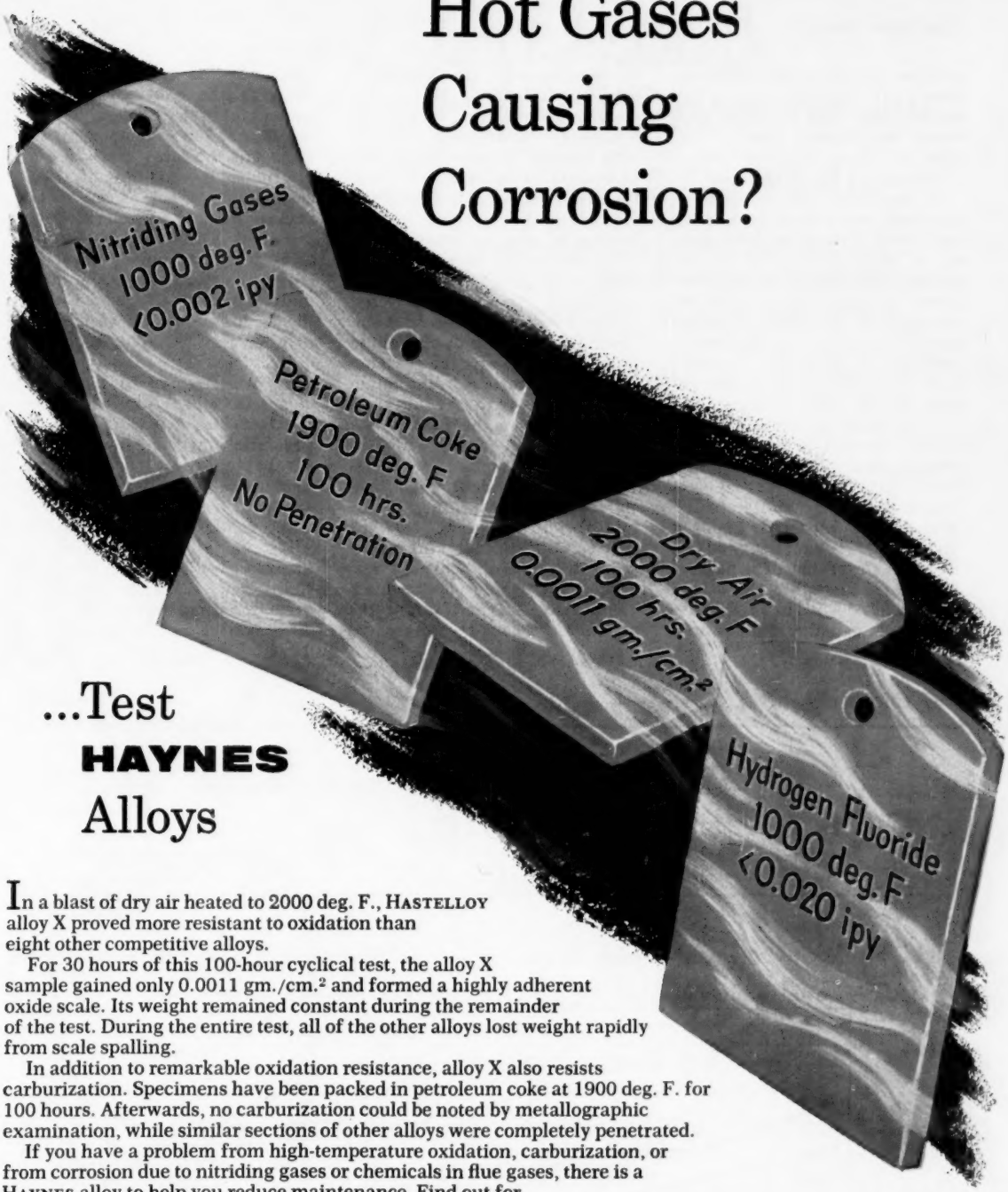
A material was needed that could handle these mixtures under reactor conditions and also have useful structural properties. Of greatest importance were: Resistance to corrosion from fluoride fuels and salts (in a neutron flux); oxidation resistance in air; good elevated temperature strength.

Most promising from a corrosion standpoint were copper, columbium, molybdenum, Inconel, and Hastelloy alloy B. However, each had serious drawbacks. The elemental metals were either unsuitable for fabrication or could not take the high operating temperatures (1,000-1,600 F.). Inconel had too high a chromium content for reasons to be discussed. Hastelloy alloy B, which contains no chromium, could not withstand the high temperatures for long periods of time without oxidation and embrittlement.

►**Usual Alloys Failed**—None of these commercial materials was completely suited to the rigorous service in a circulating fuel reactor. Tests with Inconel and Hastelloy alloy B indicated that the answer was a new nickel-base alloy. Of the compositions investigated, one known by the development designation Inor 8 was most attractive. Development of this alloy was described at the Geneva Conference for Peaceful Uses of Atomic Energy in Paper 1,990, "Metallurgical Problems in Molten Fluoride Systems", given by ORNL.

While a prime purpose of the alloy was for a reactor fuel container, it has also shown

Hot Gases Causing Corrosion?



...Test HAYNES Alloys

In a blast of dry air heated to 2000 deg. F., HASTELLOY alloy X proved more resistant to oxidation than eight other competitive alloys.

For 30 hours of this 100-hour cyclical test, the alloy X sample gained only 0.0011 gm./cm.² and formed a highly adherent oxide scale. Its weight remained constant during the remainder of the test. During the entire test, all of the other alloys lost weight rapidly from scale spalling.

In addition to remarkable oxidation resistance, alloy X also resists carburization. Specimens have been packed in petroleum coke at 1900 deg. F. for 100 hours. Afterwards, no carburization could be noted by metallographic examination, while similar sections of other alloys were completely penetrated.

If you have a problem from high-temperature oxidation, carburization, or from corrosion due to nitriding gases or chemicals in flue gases, there is a HAYNES alloy to help you reduce maintenance. Find out for yourself by testing them.

We'll gladly send you samples. But to make sure we send you the alloy or alloys most nearly suited to your need, we ask that you send a letter outlining your own particular conditions. If you would like to learn more about alloy X, ask for a copy of the booklet, "HASTELLOY Alloy X."

HAYNES ALLOYS

HAYNES STELLITE COMPANY

Division of Union Carbide Corporation

Kokomo, Indiana

UNION CARBIDE

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promise both as a high-temperature and corrosion-resistant metal. The alloy is now produced by Haynes Stellite Co. (Div. of Union Carbide Corp.) and is called Hastelloy alloy N.

In general, most corrosion problems are solved in one of two ways. One is by formation of a passive film to shield against the corrosive environment. The other is through establishment of thermodynamic equilibrium between the material and a corrosive environment before significant corrosion occurs. The first method is used quite successfully with metals exposed to gas or high-temperature water but it works with only limited success on liquid metals or molten salts. The latter, especially molten fluorides, are excellent fluxes. Because formation of a passive film was not possible, the search narrowed down to a nickel-molybdenum alloy that would be most nearly in thermodynamic equilibrium with its proposed environment.

▶ **Keys to Success**—In studies with Inconel, it was found that chromium was removed from the alloy leaving sub-surface voids, similar to those caused by loss of zinc in brass. Some of these voids extended to a depth of 30 mils below the metal surface.

The most important reaction, involving leaching of chromium from the alloy, was the reaction on solute atoms of chromium in the alloy with the uranium tetrafluoride in the fuel:

$$Cr + 2UF_4 \rightleftarrows 2UF_3 + CrF_2$$

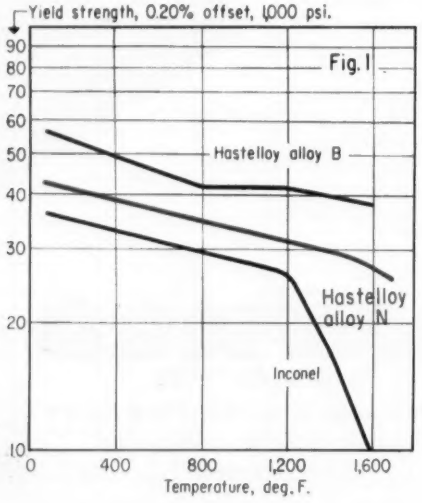
Since the reaction is reversible, and dependent upon temperature, various values of the equilibrium constant for the molten salt and container alloy were determined. Purpose was to find a way to stop chromium from being leached out of the hot end of a heat exchanger and redeposited in a mass-transfer effect at the cold end by the tendency toward reversal of the reaction at lower temperatures. With salt mixtures most useful as fuels, it was found that chromium content of not more than 8% could be tolerated in the alloy. This is far below the level in most commercial corrosion-resistant alloys. A minimum level of 6% was established for oxidation resistance to 1,500 F.

Molybdenum content of the alloy was limited to 18%, for complete solution of that element in nickel in the 1,500 F. precipitation range. In this way, aging and consequent embrittlement at the operating temperatures were eliminated. Tests made later on Hastelloy alloy N for 2,000-hr. periods showed no significant effect of aging on ultimate strength, yield strength, elongation, elastic modulus or hardness.

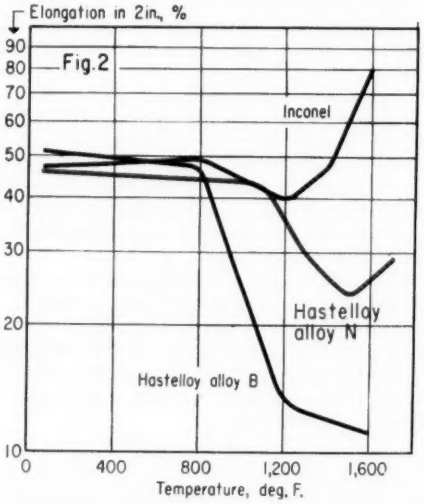
Mo and Cr Are Keys to Composition (Table I)

	Ni	Mo	Cr	Fe	Si	Mn	C	Others
Hastelloy alloy N	Bal.	15-18	6-8	5 max.	0.5 max.	0.8 max.	0.04-0.08	B:0.01 max. Al+Ti: 0.5 max.
Inconel	Bal.	——	14-17	6-10	0.5 max.	1.0 max.	0.15 max.	Cu: 0.5 max.
Hastelloy alloy B	Bal.	26-30	1.0 max.	4-7	1.0 max.	1.0 max.	0.05 max.	V: 0.20-0.60 Co: 2.5 max.

Yield Strength: Between B and Inconel



Elongation: Strength Indicator



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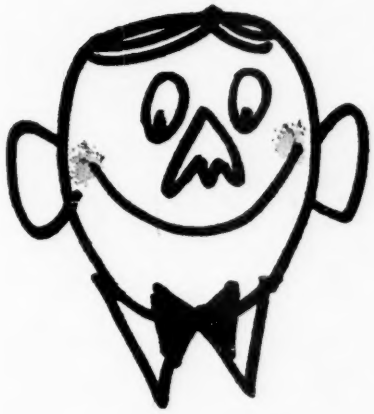

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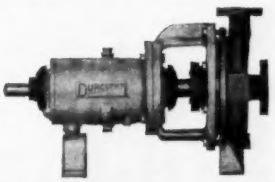

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With optimum chromium and molybdenum contents established, a limit of 5% for iron content was set so that chromium could be added as ferrochrome rather than pure chromium metal. Impurity limits on sulfur, phosphorus, and boron were also imposed to eliminate hot shortness.

▶**Best Combination** — Final chemical composition of Hastelloy alloy N is given in Table I along with those for Inconel and Hastelloy alloy B. As might be expected, alloy N is intermediate in high-temperature strength between Hastelloy alloy B and Inconel — alloy B being the strongest (Figs. 1 and 2 for sheet are on p. 164).

Table III gives an idea of the oxidation resistance of alloy N. These data were obtained by testing 17% molybdenum alloys containing increased amounts of chromium.

Note the drastic change in oxidation rate at about 6% chromium. In this nickel-molybdenum-chromium system, the oxide changes at the 6% level from a $NiMoO_4$-type to one that is predominately Cr_2O_3. The $NiMoO_4$ (below 6% chromium) spalls on cooling and accounts for the continuous oxidation thorugh thermal cycling. The Cr_2O_3 oxide does not spall as readily and forms a protective scale which reduces the oxidation rate.

Oxidation rate of an alloy with lower chromium, such as Hastelloy alloy B, would be affected by frequency of the thermal cycling. The rate of a material, such as Inconel, which contains higher chromium and no molybdenum would be less affected.

Thermal convection loop tests (Table IV) with Hastelloy alloy N have indicated very little attack from NaF-KF-LiF-UF_4 mixtures for 1,000 hr. and temperatures to 1,650 F. In tests of this nature, alloy N shows definite superiority over alloy B and Inconel. At temperatures below 1,300 F, tests have been extended to periods of over 2,000 hr. with no visible corrosion. Similar resistance has been noted in NaF-BeF-UF_4 at 1,200 F.

▶**Can Be Fabricated** — Final testing of the alloy at Oak Ridge has involved the fabrication of heat exchangers, pumps and large scale loops both in- and out-of-pile. The alloy has excellent fabricating properties and has been forged and welded. It has also been extruded and cold-drawn into seamless tubing.

At Haynes Stellite, corrosion resistance of the alloy is being investigated in a number of other troublesome media encountered in the chemical process industries.

Alloy N is commercially available at Haynes Stellite in wrought forms; and as sand-, resin shell- and investment-cast parts. Wrought forms include sheet, plate and bar.

Alloy N Shines in Three Areas . . .

. . . good physical properties . . . (Table II)

Properties	Hastelloy Alloy N	Inconel	Hastelloy Alloy B
Density, lb./cu. in.	0.317	0.307	0.334
Melting range, deg. F.	2,370-2,430	2,540	2,408-2,462
Mean coefficient of thermal expansion, in./in./deg. F. (70-1,600 F.)	0.00000810	0.00000896*	0.00000778
Specific heat	0.095	0.109	0.0907

* (100-1,400 F.)

. . . low oxidation rates** . . . (Table III)

Percent Chromium	Wt. Gain in 168 Hr., Mg./Sq. Cm.	
0.00	10.44	
2.83	16.46	
4.61	12.45	
5.43	17.83	
6.19	0.44	Hastelloy alloy N
6.86	0.60	
7.97	0.31	

** Oxidation rates of Ni + 17% Mo-Cr alloys at 1,800 F.

. . . excellent corrosion resistance† (Table IV)

Alloy	Length of Test, Hr.	Temperature, Deg. F.	Corrosive Attack, Mils
Inconel	630	1,500	35
Hastelloy alloy B	2,000	1,650	2
Hastelloy alloy B	1,000	1,830	3
Hastelloy alloy N	1,000	1,650	<1
Hastelloy alloy N	2,000	1,300	<1

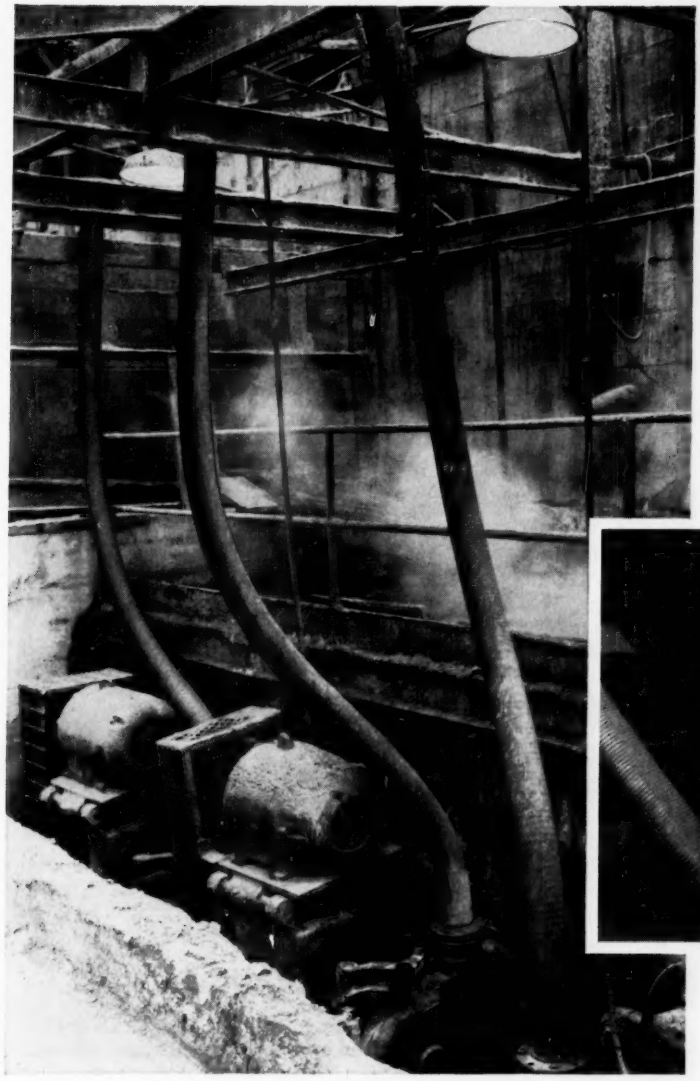
† Thermal convection loop corrosion tests. (Operating with 11.2 mol. % Na F, 45.3 mol. % LiF, 41.0 mol. % KF and 2.5 mol. % UF_4)

F. S. BADGER, *is vice president, metallurgy, Haynes Stellite Co. and vice president of Metals Research Laboratories, Niagara Falls, N. Y. Mr. Badger joined Union Carbide in* 1934 *as a research metallurgist, a few years after obtaining his BS and MS degrees from M.I.T. He is a recognized authority in the field of high-temperature metals, with a number of major articles and books on this subject to his credit. Mr. Badger is a member of AIME, ASM, IAS, and ARS.*

US RUBBER PILOT PIPE

Abrasion in piping?

Here's how a big uranium mill solved it with "U.S." flexible rubber pipe



• Four 8" U. S. Pilot Pipes carry fine screened ore from secondary crusher storage bins. Four more pipes feed too-coarsely crushed aggregate onto a conveyor belt and back into the crusher. On both jobs, Pilot Pipe has lasted over 4 years.

• In this severe service, quenched calcined ore pulp – 50% solid – is pumped through these lengths of U. S. Pilot Pipe, from the roaster calcine pumps.

Where to get flexible piping that can stand up to severe abrasion without being chewed up?

Union Carbide's Uravan mill found the answer in U. S. Pilot® Pipe and Pinch Valves. In addition to the operations pictured above, these products handle the slurry on the 9 separate pumping stations of the counter-current decantation wash circuit, are used on the 2 booster stations between leach and tailings disposal plants and between the primary acid leach and roaster.

This pipe is specially built to handle abrasive materials, such as calcined ore, *and corrosive* materials, such as solutions containing sulfuric and hydrochloric acids. It is flexible, easy to install and won't build up. Its service life is longer than that of metal pipe.

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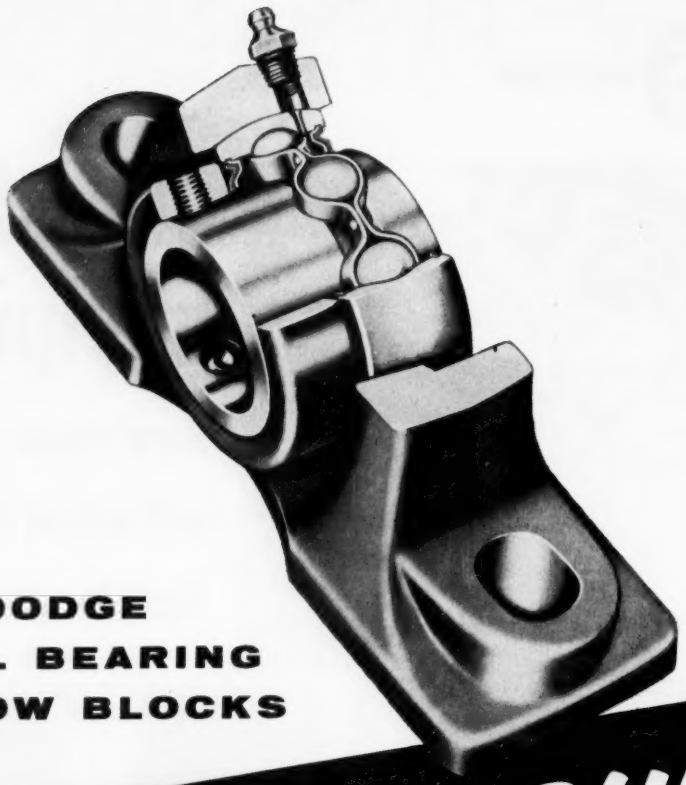

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BALL BEARING
PILLOW BLOCKS

PRECISION BUILT
– for normal and medium duty jobs

SC

NORMAL DUTY
SHAFT SIZES — 1/2" to 2-7/16"

SCM

MEDIUM DUTY
SHAFT SIZES — 1-7/16" to 3-1/2"

CALL THE TRANSMISSIONEER—your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look in the *white* pages of your telephone directory for "Dodge Transmissioneer."

- ★ High quality at moderate cost.
- ★ Deep groove ball bearing provides high radial and thrust capacity.
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Pillow blocks, flange bearings, piloted flange bearings, cylindrical units, hanger bearings, screw conveyor hanger bearings.
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FIRMS IN THE NEWS

R. A. LABINE

NEW FACILITIES

May's Top Projects:

Gulf Oil Corp. will soon start construction on a new multi-million-dollar Oxo alcohol plant at its Philadelphia refinery. Unit—primarily for production of isooctyl and decyl alcohols—will quadruple firm's Oxo product capacity. On stream date: middle of 1960.

Chrysler Corp. is investing $6 million to equip its own glass fabrication facility in Detroit. Decision was brought on by a production loss of 100,000 cars during the Pittsburgh Plate Glass strike. PPG will continue to supply Chrysler with 50% of its glass needs.

Texas Gulf Sulphur is building a molten sulfur storage terminal at Tampa, Fla., that will be in operation by August. Molten sulfur will be shipped from Beaumont, Tex., in a special seagoing tanker holding 7,500 tons.

Allied Chemical announces completion of new phthalate ester plasticizer facilities at firm's Toledo, Ohio, plant. Cost and capacity of the new unit were not revealed.

Linde has completed the major construction phase of the $5-million liquid oxygen-nitrogen plant at Pittsburg, Calif. When unit goes on stream around June 1, its 115-million-cu.-ft./mo. output of liquids will make it the largest in the country, according to Linde.

Wyandotte Chemicals has started up its new chlorine-caustic plant at its Geismar Works, 25 mi. south of Baton Rouge, La. When fully completed later this year, plant will have a capacity of 300 tons/day chlorine and 330 tons/day of caustic.

Flintkote's subsidiary Utah Lime & Stone Co. will use the Corson lime hydration process of the G. & W. H. Corson Co. at a new $1-million lime plant now under construction at Dolomite, Utah. A similar process for production of "miracle lime" is being used by Flintkote's U. S. Lime Products Co. division at Henderson, Nev.

Parke, Davis & Co. has started construction of a $2.2-million sales office and manufacturing facility in Bombay, India. Seven-building complex, to be finished by May 1960, will produce a complete line of pharmaceutical and antibiotic products.

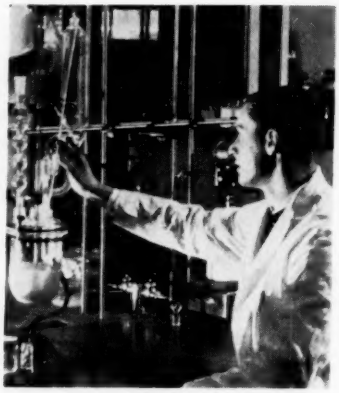
Pan American Sulphur Co. has construction under way on a $500,000 dry bulk and liquid sulfur storage facility at Tampa, Fla. Storage capacity will be around 65,000 tons.

Imperial Oil is expanding its Edmonton refinery with the addition of a 1,500-bbl./day alkylation unit. Construction on the $2.4-million unit will start in September and be completed by April 1960.

Pecora, Inc., manufacturer of caulking compounds, tile adhesives and other products,

FIRMS . . .

plans to erect a new 10,000-sq.-ft. plant in Garland, Tex., 10 mi. from Dallas.



Air Reduction Chemical Co. recently opened a new $400,000 laboratory and engineering office building in Bound Brook, N. J. Chemist in the photo above is studying a new emulsion product.

Western Plywood Co. will build a $2.5-million plant on Deas Island in the Fraser River near Vancouver, B.C. Production will begin late in 1960.

Western Nuclear Corp. has awarded Western-Knapp Engineering Co. a $1-million contract to expand its Split Rock uranium mill at Jeffrey City, Wyo. Expansion will increase capacity from 440 tons/day to 1,290 tons/day.

Federal Aviation Agency's Sixth Region in Honolulu, Hawaii, has awarded Cleaver-Brooks a $178,000 contract to supply sea water desalting equipment. Firm will build two 50,000-gal./day flash evaporators for delivery to Wake Island by May.

Cenco Instruments Corp. is reaching for European markets, will construct a 27,000-sq.-ft. instrument and scientific apparatus manufacturing facility in Breda, Holland.

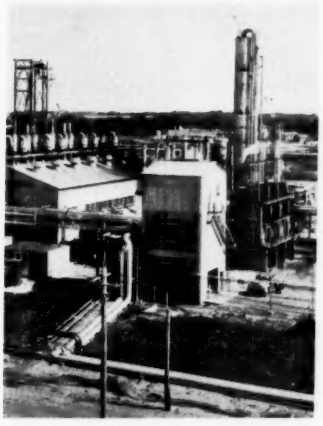
Minnesota Mining & Manufacturing Co. will begin con-

struction on a 100,000-sq.-ft. magnetic products plant at Freehold, N. J., late this summer. Production will begin late in 1960.

Crown Cork & Seal Co. announces plans for construction of a 80,000-sq.-ft. can manufacturing facility in Winchester, Va.

Inland Steel Co.'s Container Div. is completing construction of a steel-container manufacturing facility in Jersey City, N. J.

Metal & Thermit Corp. has purchased previously leased facilities in suburban Detroit for the company's electrochemical research laboratory and pilot plant. Plans call for accelerated research programs in chromium, copper, nickel and tin plating.



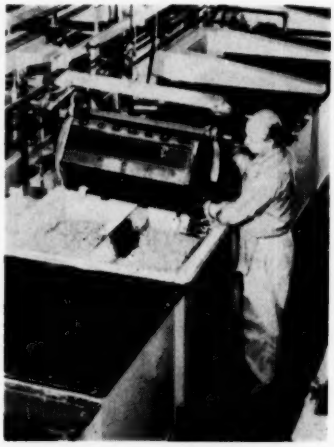
St. Paul Ammonia Products' ammonia plant at Pine Bend, Minn., is now operating at rates above its design capacity of 200 tons/day. Plant, designed and built by Lummus, runs on natural gas during most of the year but switches to butane in the winter when natural gas is in short supply.

Texas Eastern Transmission Corp. is constructing what is expected to be the largest single underground reservoir for liquefied petroleum gases in the nation. Site is a giant salt dome about 25 mi. east of

FIRMS . . .

Houston, Tex. When completed, wells will hold 42 million gal. of LPG destined for midwestern and eastern markets.

Crown Cork & Seal Co. has work under way on its $7-million can and crown manufacturing plant in Atlanta, Ga. Initial section of the plant will cover 250,000 sq. ft.

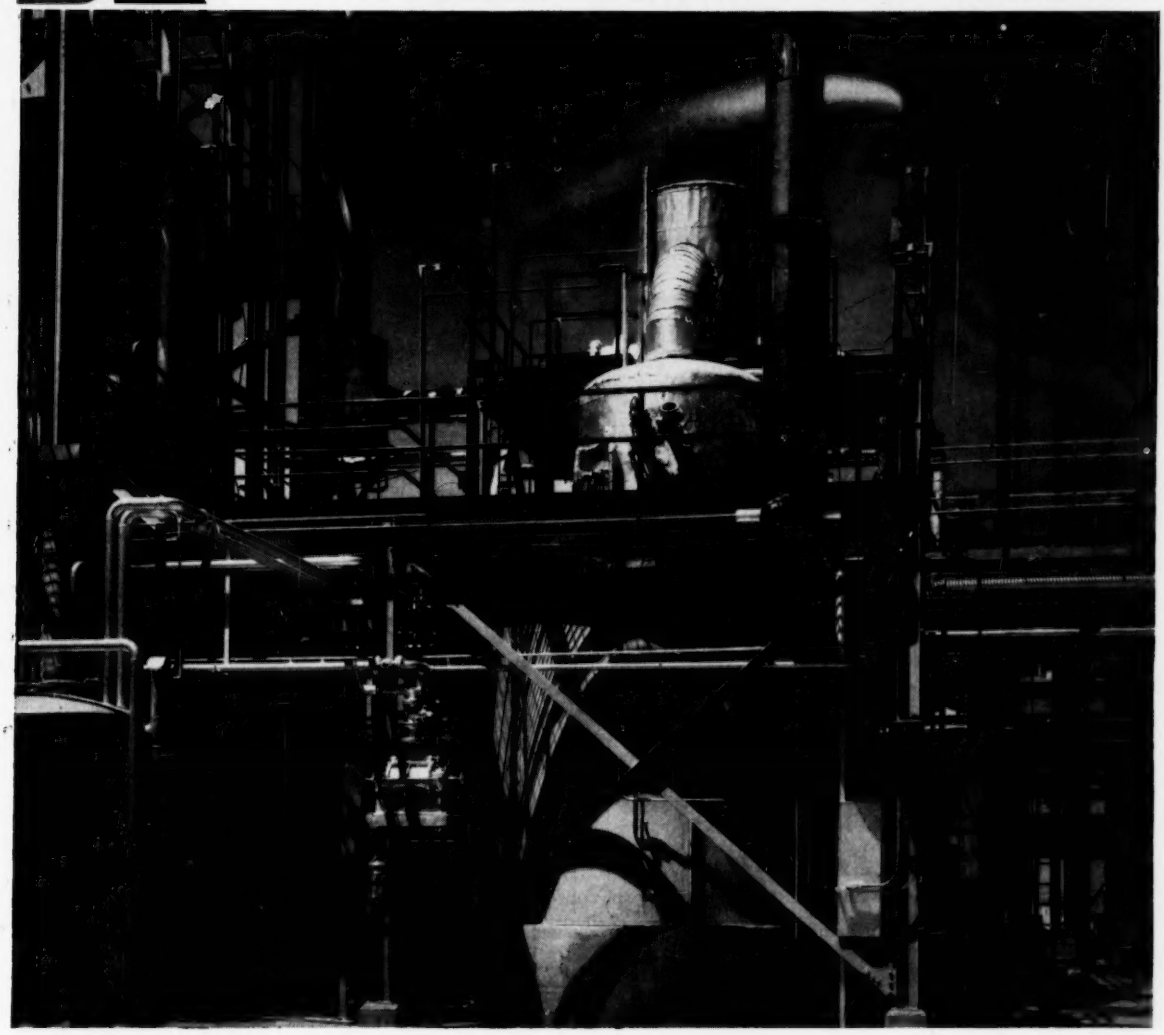


Standard Pressed Steel Co. has added a $100,000 plating facility to its Jenkintown, Pa., plant to apply diffused nickel-cadmium, nickel, copper and silver coatings on structural parts used at temperatures up to 1,400 F.

Camdale Corp. of New York, which owns producing oil properties in Texas and Kentucky, has purchased controlling interest in Commercial Fibreglas Products of Houston, Tex., which markets a line of fiberglass tanks for the chemical industry.

Shell Petroleum and Bataafsche Petroleum have organized four new companies: Shell International Petroleum (London) for oil; Shell Inter-

Blaw-Knox builds for HumKo, ***Division National Dairy Products Corp.,*** **a radiant heated batch fatty acid still. Supplementing a continuous still previously supplied by Blaw-Knox, this new unit increases HumKo's output of fatty acids and improves production efficiency.**



Industry's first radiant furnace cuts fuel costs... tightens temperature control

New economies for batch fatty acid distillation are introduced with the Blaw-Knox Radiant Furnace. Proven and popular in resin and plastic operations, this unique furnace brings the same design advantages to the fatty acids industry.

The furnace features a light, stainless steel shell surrounded by light weight, high temperature insulating material. About 75 percent of the heat to the batch is supplied by radiation from furnace walls. This speeds heating and provides improved response to temperature control. Low heat retention and effective insulation cut heat losses, account for significant fuel savings. Reduced maintenance is an added bonus.

The radiant furnace is a pace setting product of a continuing process development program. *Experienced initiative* sparks all projects undertaken by Blaw-Knox's complete engineering and construction service.

When planning your next project—a new plant, or modernization, or expansion, contact Blaw-Knox Company, Chemical Plants Division. Headquarters in Pittsburgh. Branch offices in New York, Chicago, Haddon Heights, New Jersey, Birmingham, Washington, D.C., and San Francisco.

for plants of distinction ...

BLAW-KNOX

FIRMS . . .

national Chemical (London) for chemicals; Bataafsche Internationale Petroleum (The Hague) for oil; Bataafsche Internationale Chemie (The Hague) for chemicals.

Western Petrochemical Corp., newly formed company, is acquiring Warwick Wax Co., a wholly owned subsidiary of Sun Chemical Corp. Warwick had estimated sales of $3 million during 1958.

General Electric is withdrawing from the custom molded plastics business with the sale of the Taunton, Mass., plant and much of the equipment of the Decatur, Ill., plant to Haveg Industries, Wilmington, Del.

Marine Colloids, Inc., with head offices at 24 State St., New York, is a new firm formed by the merger of Algin Corp. of America and Seaplant Corp.

OVERSEAS BRIEFS

Cyprus Mines Corp., Los Angeles, and the Dutch firm of Albatros Superfosfaatfabrieken plan to build "one of the largest sulfuric plants in the world" at Pernis near Rotterdam, The Netherlands. Unit will burn pyrites shipped by Cyrus.

Britain's second power-producing nuclear installation—the Chapelcross nuclear station—has begun feeding power into the national grid system. Station has a generating capacity of 140,000 kw., about twice that of the Calder Hall station on which its design is based.

Argentina has accepted the offer of Butadiene & Chemical International, Houston, Tex., to invest $40-67 million in Argentinian petrochemical plants. Plans call for units

in the Comodoro Rivadavia area to produce 30,000 tons/yr. butadiene and enough styrene to turn out 40,000 tons/yr. SBR rubber. Rubber capacity will eventually be expanded to 60,000 tons/yr.

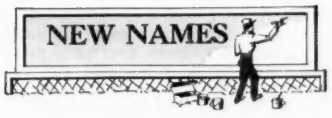
Rumania's new Navodari superphosphate fertilizer plant (designed by Soviet engineers) is on stream and is slated to produce 150,000 metric tons this year. Capacity will be increased to 250,000 metric tons during 1960.

NEW REPRESENTATIVES

Petro-Chem Development Co. announces that its wholly-owned Canadian subsidiary, Petrochem Isoflow Furnaces, Ltd., will now handle all sales and services of Isoflow furnaces in Canada.

Consolidated Electrodynamics Corp. has granted Van Waters & Rogers, Inc., exclusive marketing rights to two models of CEC's moisture monitors in the 11 western states.

Coyne Cylinder Co. of San Francisco has been appointed distributor for Cambridge Co.'s Liqua-Guard line of commercial cryogenic equipment in the 11 western states.



National Aluminate Corp. is planning to change its name to Nalco Chemical Co. Proposed name change is being voted on by firm's stockholders.

National Starch Products is changing its name to National Starch & Chemical Corp. "reflecting the increased importance of chemical products and processes in the company's business."

CALENDAR

American Society of Mechanical Engineers, Maintenance & Plant Engineering Division Conference, Edgewater Beach Hotel.
May 4-5 Chicago, Ill.

American Institute of Chemists, annual meeting, Hotel Traymore.
May 6-8 Atlantic City, N. J.

Institution of Chemical Engineers-Society of Instrument Technology-British Computor Society, symposium: Instrumentation and Computors in Process Development and Plant Design, Central Hall, Westminster.
May 11-13 London, England

Operations Research Society of America, national meeting, Shoreham Hotel.
May 14-15 Washington, D. C.

International Petroleum Exposition,
May 14-23 Tulsa, Okla.

American Institute of Chemical Engineers, national meeting, Hotel Muehlebach.
May 17-20 Kansas City, Mo.

American Ceramics Society, annual meeting, Palmer House.
May 17-21 Chicago, Ill.

Chemical Specialties Manufacturers Assn., Drake Hotel.
May 18-20 Chicago, Ill.

Commercial Chemical Development Assn., annual resort meeting, Pocono Manor.
May 25-26 Poconos Mts., Pa.

Chemical Institute of Canada, 42nd annual conference, Nova Scotian Hotel.
May 25-27 Nova Scotia, N. S.

American Society for Quality Control, annual meeting, Hotel Sheraton.
May 25-27 Cleveland, Ohio

Technical Assn. of the Pulp and Paper Industry, 10th Coating Conference, Statler Hotel.
May 25-27 Boston, Mass.

American Society of Mechanical Engineers, Design Engineering Conference, Convention Hall.
May 25-28 Philadelphia, Pa.

American Petroleum Institute, Refining Div. midyear meeting, Hotel Statler.
May 27-30 New York, N. Y.

Fifth World Petroleum Conference and Exposition, N. Y. Coliseum. See p. 58 for listing of technical papers.

American Material Handling Society, national conference, Cleveland Auditorium.
June 9-11 Cleveland, Ohio

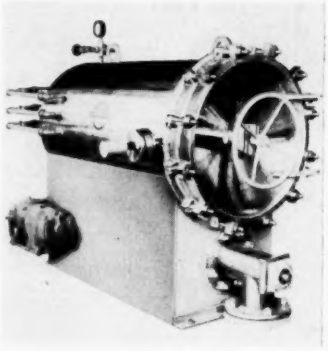
Material Handling Institute, annual exposition, Cleveland Auditorium.
June 9-12 Cleveland, Ohio

American Society of Mechanical Engineers, semi-annual meeting, Chase-Park and Plaza Hotels.
June 14-18 St. Louis, Mo.

NEW EQUIPMENT . . .

(*Continued from p. 76*)

chamber, mounts on the conveying line. Remaining circuitry is remotely located. The system comes with either dial indication or standard strip-chart recorder. — **The Curtiss-Wright Corp., Electronics Div., Carlstadt, N. J.** **76E**



Filter

Delivers dry cake. Plates operate in two positions.

According to the manufacturer, the new Model HR diatomite filter combines the cake stability of a horizontal plate with automatic dry-cake discharge.

In use, the plates are precoated and operated in a horizontal position. Then the plates mechanically rotate to a vertical position, and a tap or two on the external agitator bar knocks off the cake; a vibrator will do the same job.

A screw conveyor removes spent cake as a dry powder. The filter need not be opened for cleaning. Electronic controls for automatic operation are optional.—**The Sparkler Mfg. Co., Mundelein, Ill.** **178A**

Flow Calculators

Put factors of piping design at user's fingertips.

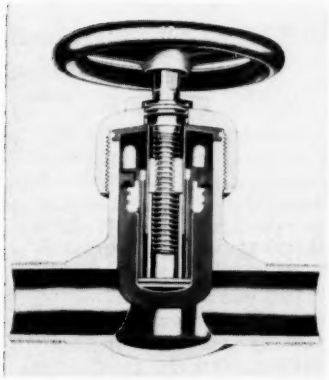
Two circular calculators made of heavy-duty plastic greatly simplify the determination of pipe diameter, pressure drop, flow volume, and other

variables of fluid flow problems. One model is for turbulent flow; the other for streamline flow.

Front side of the turbulent-flow model solves fundamental flow formulas with high accuracy. Friction factors are built in; they need no separate determination. The reverse side carries scales that provide an instantaneous check on whether flow is streamline or turbulent. The scales also give viscosities at various temperatures for over 50 commonly used liquids.

Scale ranges are as follows: liquid flow—5 to 1,000,000 gph.; gas flow—50 to 1,000,000 cfh.; diameter—¼ to 40 in.; pressure drop—0.01 to 500 psi.; length—5 to 10,000,000 ft.

Streamline-flow calculators are similar in construction, but have only one engraved side. Scale ranges are not as extensive. The turbulent model costs about $5.30; the streamline calculator runs $3.10.—**Fearns, Mear & Co., Almondbury, Huddersfield, England.** 178B



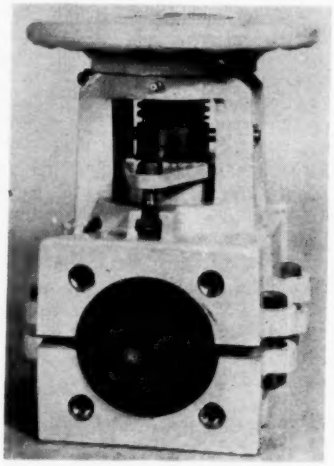
Plastic Valve

Corrosion-resistant unit features tight seal.

According to the manufacturer, a new valve of all-plastic construction features an absolutely dependable method of tight sealing. Employing a telescopic arrangement instead of a diaphragm, the valve stem forces a soft-rubber cup to the concave bottom of the flow passage. Because of its flexibility, the cup seals on all sides against

the walls of the body casing, positively shutting off fluid flow.

Suitable for installation in either metal or plastic piping systems, the valve comes in a variety of plastic materials. Working pressure is 145 psi.; flanged, screwed or socket ends. Available sizes from 1 to 4 in.— **W. S. Rockwell Co., Fairfield, Conn.** **179A**



Graphite Valve

First model now available. Other sizes to come soon.

Impervious graphite is the functional material of construction for a new globe valve. Now available in the 2-in. size, Type G valves will be offered later in 1-, 1½-, 3- and 4-in. sizes as well.

Designed for service up to 100 psi., the valve has a steel casting enclosing its body to prevent damage from external mechanical shock. The seat is made of carbon and Teflon to eliminate galling and sticking. Valve spindle is nonrotating.— **National Carbon Co., New York, N. Y.** **180A**

Transmission Belt

Chrome-tanned leather is bonded to nylon.

Developed in Europe and introduced to the North American market about three years ago,

the Extremultus belt is showing good form in machinery drive applications previously considered impossible for transmission belts of any kind. The belt's success stems from the combined properties of its materials of construction.

Load-carrying member of Extremultus belts consists of one or more laminations of highly elastic nylon having a tensile strength of 28,500 psi. Bonded to the nylon is a leather surface specifically tanned for maximum friction coefficient rather than for strength or stretch properties.

Actual friction coefficient of the belt (0.7 to 0.8) is two or three times higher than that of other belting materials. This minimizes slippage and enables very high starting torques, even with very narrow sizes.

Extremultus belts can be quickly and easily spliced to form a smooth, strong joint.— **Extremultus, Inc., New York, N. Y.** **180B**

BRIEFS

Line starter Condulet enclosures accept and operate any of the various makes of motor starters and circuit breakers. Single-speed nonreversing combinations come equipped with a universal mounting plate, motor-starter reset assembly and circuit-breaker operating assembly. Two models: Type DNC (Dust-Ignition-Proof) and Type WNC (Watertight).— **Crouse-Hinds Co., Syracuse, N. Y.** **181A**

Cleaning tool applies solvents used in the chemical washing of storage tanks. Designed for all kinds of tanks and tank cars, the tool jets solvents from two nozzles in a revolving head powered by a hydraulic motor. — **Dowell Div., Dow Chemical Co., Tulsa, Okla.** **181B**

Repair clamp known as the Handiband quickly repairs leaks in steel piping. Easy to install, the clamp comes in sizes for ½- to 8-in. pipe, and

in 3-, 8-, 9- and 12-in. lengths. Construction is stainless steel with a rubber-compound gasket.—**Dresser Mfg. Div., Bradford, Pa.** 181C

Readout display unit having characters 3¾ in. high by 2 in. wide can be read at distances up to 100 ft. Characters are offered in colors, as well as in any style the user desires. Individual cost is $33.—**Industrial Electronic Engineers, North Hollywood, Calif.** 182A

Reagent head inexpensively converts the manufacturer's controlled-volume diaphragm pump into a corrosive-liquid handler suitable for any process operation. The head's chemical porcelain is completely free of uncombined iron or other metallic impurities. Gaskets, diaphragm, valve seats and valve stops are made of Teflon.—**Lapp Insulator Co., LeRoy, N. Y.** 182B

Package unit, including scrubber, transition and fan will handle sulfuric, hydrochloric and low-concentration nitric acid fumes in continuous or batch pickling systems. Having fan-blade sizes ranging from 27 to 49 in., the new unit can accommodate volumes from 5,000 to 40,000 cfm.—**Robinson Ventilating Co., Zelienople, Pa.** 182C

Air-actuated valves manufactured from Type 304 stainless steel are fully corrosion resistant, and are said to assure maximum, uninterrupted flow. Designed for local or push-button remote control, the valves are available in direct-acting or reverse-acting styles. Single- and double-position models.—**Ladish Co., Kenosha, Wis.** 182D

Effluent sampler powered by dry batteries delivers a continuous sample at a rate of 2 gal. per 24-hr. period. The unit's pump is self-priming and will suction-lift up to 10 ft. All components contacting the sample are chemically inert. Electrical components are explosion-proof.—**Brailsford & Co., Inc., Rye, N. Y.** 182E

Shaft-failure indicator detects slowdown or stoppage of shafts turning at less than 2 rpm. The all-metal, self-lubricated units have internal gearing available in three different ratios: 10:1; 5:1; and 2:1.—**Winterburn Mfg. Co., Putnam, Conn.** 183A

Electron-beam welders can join high-temperature reactive metals and super alloys. Known as Beamatrons, the units can weld tubing or parts up to 3½ in. dia. and in lengths up to 10 ft. All controls, instruments and the high-voltage power supply are housed in a console-style cabinet. — **High Vacuum Equipment Corp., Hingham, Mass.** 183B

Vapor fractometer can pick up components at a level of approximately 10^{-9} g. without difficulty. At 160 F., it will separate hydrocarbon components from C_5 to C_{12} in a reasonable time. Utilizing a flame ionization detector, the instrument eliminates the need for helium and the necessity of a balance reference. — **Perkin-Elmer Corp., Norwalk, Conn.** 183C

Equipment Cost Indexes . . .

	Sept. 1958	Dec. 1958
Industry		
Avg. of all	230.9	231.3
Process Industries		
Cement mfg.	223.3	223.7
Chemical	232.3	232.7
Clay products	217.0	217.4
Glass mfg.	219.3	219.7
Paint mfg.	222.8	223.1
Paper mfg.	223.8	224.2
Petroleum ind.	227.5	227.8
Rubber ind.	230.3	230.6
Process ind. avg.	228.6	228.8
Related Industries		
Elec. power equip.	236.0	236.4
Mining, milling	233.7	234.1
Refrigerating	260.3	260.6
Steam power	218.1	218.4

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago for 47 different industries. See Chem. Eng., Nov. 1947, pp. 124—6 for method of obtaining index numbers; Feb. 23, 1959, pp. 149-50 for annual averages since 1913.

(*Continued from p.* 58)

OIL CONGRESS TECHNICAL PAPERS

Paper No. • **Title**
Organization or author
Country • **Time given**

20. **Fluid Injection for Increased Oil Recovery.** Pan American Petroleum Corp.
USA. **Thurs. PM.**

28. **Relationship of Vapor-Liquid Equilibrium Ratios at Dewpoint Pressure to Compressibility Factors and Composition of Gas-Condensate Fluids.** U. S. Bureau of Mines.
USA. **Fri. PM.**

Oil Processes and Refining

1. **The Refiner Looks at Cars of the Future.** The Atlantic Refining Co.
USA. **Mon. AM.**

2. **Processing Needs for Higher Quality Fuels.** Universal Oil Products Co.
USA. **Mon. AM.**

3. **A New Isomerization Process.** Esso Research & Engineering Co.
USA. **Mon. AM.**

4. **Reactions in Catalytic Reforming of Naphthas.** Standard Oil Co. (Ind.); Esso Research & Engineering Co.
USA. **Thurs. PM.**

5. **Hydrogenation of Petroleum Fractions. Union Oil of Calif.**
USA. **Mon. PM.**

6. **The IFP Hydrorefining Process for Crude Oils and Petroleum Fractions.** Institut Francais du Petrole.
France. **Mon. PM.**

7. **Cobalt Molybdenum Catalysts for Hydrodesulfurization and Reforming of Petroleum Fractions.** Stazions Sperimentale Per I Combustibili; S.p.A. per l'Industria Petrolifera e Chimica; Societa Petrolifera Italiana.
Italy. **Mon. PM.**

OIL CONGRESS TECHNICAL PAPERS

Paper No. • Title
Organization or author
Country • Time given

8. **Studies on a Commercial Two Stage Catalytic Cracking Plant.** Shell Oil Co.
USA. **Tues. AM.**

9. **Catalysts Based on Montmorillenite Mineral.** Sudchemie AG.
Germany. **Tues. AM.**

10. **Study of the Nature of Activity of Alumosilicate Catalysts.** Prof. K. V. Topchieva et al.
USSR. **Tues. AM.**

11. **Chemical Changes in Lubricating Oil on Hydrofining.** Imperial Oil, Ltd.
Canada. **Tues. PM.**

12. **Hydrofining in the Manufacture of Bright Stock.** Esso Standard S. A. Francaise.
France. **Tues. PM.**

13. **Catalytic De-Aromatization of Light Distillates and the Hydro-Finishing of Lubricating Oils.** Societe Francaise des Petroles BP.
France. **Tues. PM.**

14. **Production of Lubricating Oils and Paraffin from Sulfurous Oils in the USSR.** Prof. L. G. Zherdeva, et al.
USSR **Wed. AM**

15. **Dehydrogenation of Naphthenic Lubricating Oil Fractions.** Lobitos Oilfields, Ltd.
Gt. Britain. **Wed. AM.**

16. **Sweetening Petroleum Products by Catalytic Oxidation with Sulfur Dyes.** Compagnie Francaise de Raffinage.
France. **Wed. PM.**

17. **Treating Aromatic Byproduct Gasoline from Thermal Conversions by the BASF-Scholven Process for Light Oil Refining.** Badische Anlin & Soda-Fabrick AG.
Germany. **Wed. PM.**

18. **Development in Treating Processes for the Petroleum In-**

OIL CONGRESS TECHNICAL PAPERS

Paper No. • **Title**
Organization or author
Country • **Time given**

dustry. Koninklijke/Shell Laboratorium.
The Netherlands. **Wed. PM.**

19. **Refinery Studies by Digital Computer.** Tidewater Oil Co.
USA. **Thurs. AM.**

20. **Economic Studies of Refining Problems by Means of Modern Electronic Computers.** Societe des Petroles Shell Berre.
France. **Thurs. AM.**

21. **Conjunct Polymerization of Ethylene with Heteropolyacid Catalysts.** Delft Technical University.
The Netherlands. **Thurs. AM.**

22. **Extraction of Aromatics with Sulfolane.** Shell Development Co.
USA. **Thurs. PM.**

23. **Gasoline Refining Using Adsorbents Selective for n-Paraffins.** Standard Oil Co. (Ohio)
USA. **Thurs. PM.**

24. **Elementary Processes of Mass Transfer in Extraction, Absorption and Distillation.** Institute of Chemical Technology, Braunschweig.
Germany. **Wed. AM.**

25. **The Use of Gaseous Sulfur Trioxide in the Sulfonation of Petroleum Oils.** Manchester Oil Refinery, Ltd.
Gt. Britain. **Fri. AM.**

26. **Refining of Steam-Cracked Gasoline.** The British Petroleum Co., Ltd.
Gt. Britain. **Fri. AM.**

27. **Twenty-Five Years with Fischer-Tropsch Fixed Bed Catalyst, its Present Standing and Possibilities for the Future.** Ruhrchemie AG.
Germany. **Fri. AM.**

28. **The Fluid Coking Process—Commercial Experience to Date.**

OIL CONGRESS TECHNICAL PAPERS

Paper No. • **Title**
Organization or author
Country • **Time given**

Esso Research & Engineering Co.; Tidewater Oil Co.
USA. **Fri. PM.**

29. **Processes for Continuous Thermocontact Treatment of Oil Stocks on Coke.** Prof. B. K. Amerik, et al.
USSR. **Fri. PM.**

30. **Catalytic Processing of Residual Fuel Stocks.** Houdry Process Corp.
USA. **Fri. PM.**

Chemicals From Petroleum and Natural Gas

1. **Manufacture and Utilization of Aromatics from Petroleum.** Humble Oil & Refining Co.
USA. **Mon. AM.**

2. **Two-Stage Process for Production of Napthalene and High Octane Gasoline from Cycle Stock.** Sinclair Research Laboratories, Inc.
USA. **Mon. AM.**

3. **Catalytic Dehydrocyclization of Paraffinic Hydrocarbons.** Prof. B. A. Kazansky; Prof. A. L. Liberman.
USSR. **Mon. PM.**

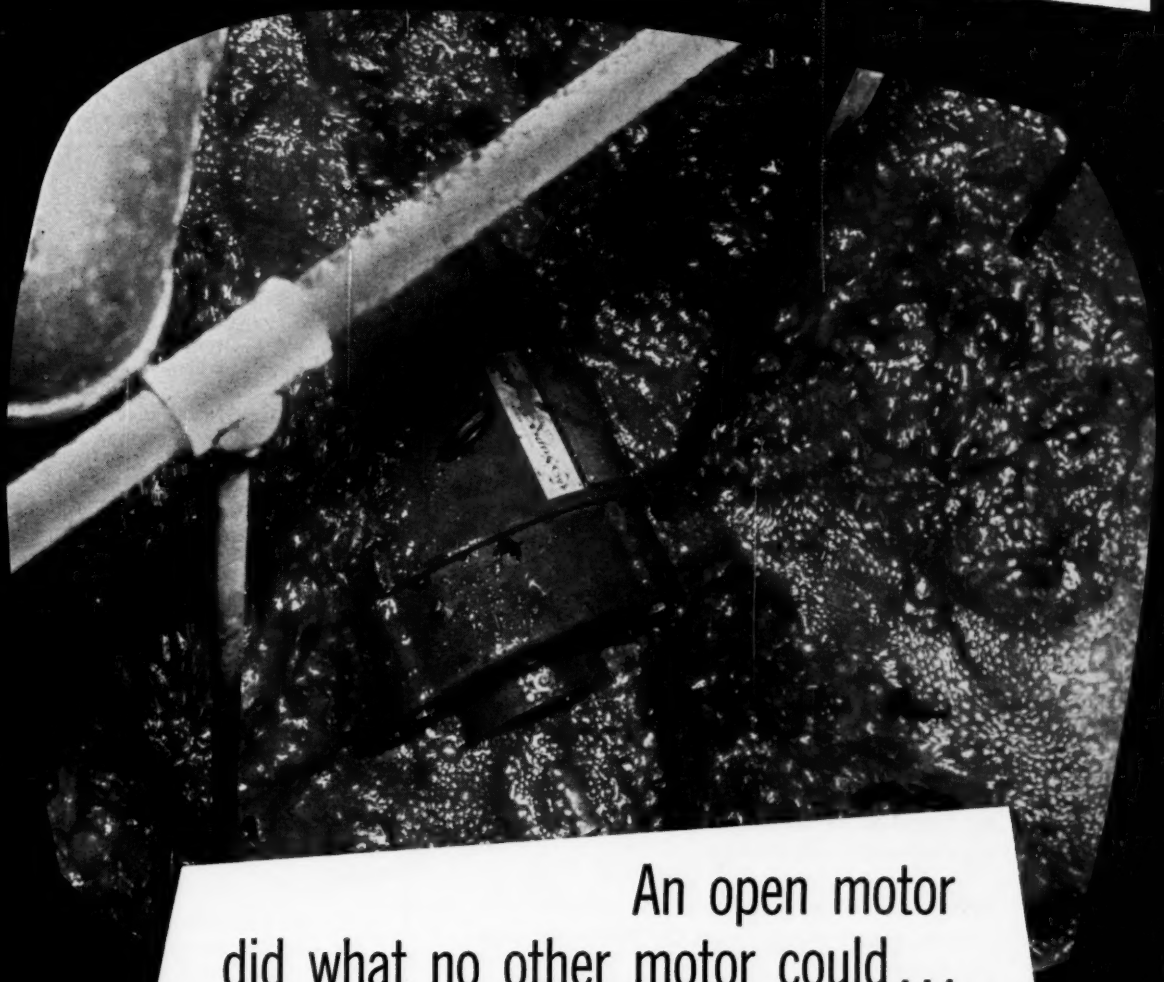
4. **Kinetics of Pyrolysis of Ethane at Practical Conversions.** Union Carbide Chemicals Co.
USA. **Mon. PM.**

5. **Fundamental Relations of the Pyrolysis of Hydrocarbons to Acetylene and Ethylene.** Farbwerke Hoechst AG.
Germany. **Mon. PM.**

6. **Acetylene Production from Pyrolysis of Liquid Hydrocarbon Feedstocks.** Societe Belge de l'Azote et des Produits Chimiques du Marly; M. W. Kellogg Co.
Belgium. **Mon. PM.**

7. **Oxidative Cracking of Pro-**

SCOPE in MOTOR DEVELOPMENT from . . . **ALLIS-CHALMERS**



An open motor did what no other motor could . . . in a mudbath

This Super-Seal motor with *Poxeal* insulation and protected bearing was not fouled by mud. An Allis-Chalmers customer, in a frequently flooded area, required a motor that could readily start even after prolonged immersion in mud.

The "dirtiest mud available" was used in conducting the successful tests in the A-C Motor Laboratories.

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A-1005-C

OIL CONGRESS TECHNICAL PAPERS

Paper No. • **Title**
Organization or author
Country • **Time given**

pane and Butane-Isobutane Mixtures. University of Pisa.
Italy. **Tues. AM.**

8. **Cracking of Gaseous Hydrocarbons by Partial Oxidation.** Badische Anilin & Sodafabrik.
Germany. **Tues. AM.**

9. **Catalytic Synthesis of Cyclopentadiene Hydrocarbons.** Professor N. I. Shuikin; Prof. T. I. Naryshkina.
USSR. **Tues. AM.**

10. **Butadiene Production—Commercial Practice with Dow Catalyst.** Dow Chemical Co.
USA. **Tues. PM.**

11. **A Process for Manufacturing Isoprene.** Institut Francais du Petrole.
France. **Tues. PM.**

12. **Manufacture of Conjugated Diolefins by Hydroperoxidation of Olefins.** Institute Francais du Petrole.
France. **Tues. PM.**

13. **The Production of Synthesis Gas by Partial Oxidation.** The Texas Co.
USA. **Wed. AM.**

14. **Recent Developments in the Oxo Process.** Gulf Research and Development Co.
USA. **Wed. AM.**

15. **Synthesis of Higher Aliphatic Alcohols by Direct Oxidation of Paraffinic Hydrocarbons.** Prof. A. N. Bashkirov; Prof. V. V. Kamzolkin.
USSR. **Wed. AM.**

16. **Hydrogen Peroxide—New Techniques for its Utilization.** Shell Development Co.
USA. **Wed. PM.**

17. **A New Process for Oxidation of Aromatics.** Standard Oil Co. (Indiana).
USA. **Wed. PM.**

(Continued)

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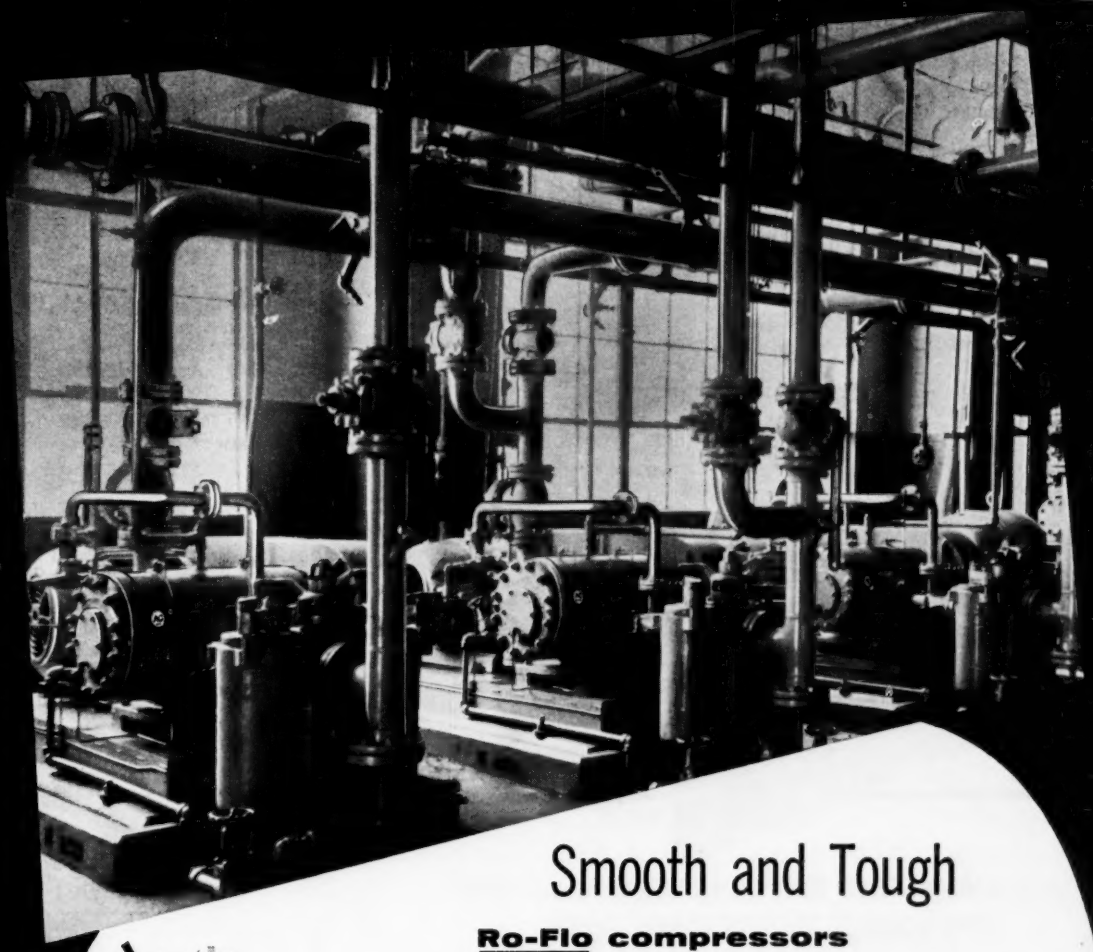
ALLIS-CHALMERS



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A-C ALLIS-CHALMERS

A-5960-C

OIL CONGRESS TECHNICAL PAPERS

Paper No. • **Title**
Organization or author
Country • **Time given**

18. **Production of Aromatic Dicarboxylic Acids.** Koninklijke/Shell Laboratorium; N. V. De Bataafsche Petroleum Maatschappij.
The Netherlands. **Wed. PM.**

19. **Acetic Aldehyde as Raw Material for Acrylonitrile.** The Knapsack Process. Knapsack Griesheim AG.
Germany. **Thurs. AM.**

20. **Detergent Alkylsulfonates Derived from Petroleum Hydrocarbons through Hydroperoxides.** Kadimah Chemical Corp.
Israel. **Thurs. AM.**

21. **Relationship between Structure of Phenyldodecane Isomers and Performance as Detergent Base Materials.** Koninklijke/Shell Laboratorium; N. V. De Bataafsche Petroleum Maatschappij.
The Netherlands. **Thurs. AM.**

23. **New Plastics from Petroleum.** Montecatini Co.
Italy. **Thurs. PM.**

24. **New Classes of Plastic, Rubbers, and Textile Fibers from Petroleum.** Instituto di Chinica Industriale Politecnico di Milano.
Italy. **Thurs. PM.**

25. **Some Relationships of Polymerization of Alpha-Olefins on Complex Metal-Organic and Oxide Catalysts.** Prof. A. V. Topchiev; Prof. B. A. Krentsel.
USSR. **Thurs. PM.**

26. **Polymerization of Acetylene and Homologs.** Phillips Petroleum Co.
USA. **Fri. AM.**

27. **Oil Extension of Synthetic Rubbers.** Polymer Corp.
USA. **Fri. AM.**

28. **Summary of the Synthetic Fiber Industry.** Chemstrand
USA. **Fri. AM.**

OIL CONGRESS TECHNICAL PAPERS

Paper No. • Title
Organization or author
Country • Time given

29. **Improved Process for Sulfur Recovery from Refinery Gases.** The Atlantic Refining Co.
USA. **Fri. PM.**

30. **Thianaphthene and Homologs from Hydrocarbons and Hydrogen Sulfide.** Texas Co.
USA. **Fri. PM.**

31. **Integration of Petroleum Chemicals Operations.** Imperial Chemical Industries, Ltd.
Gt. Britain. **Fri. PM.**

Utilization of Petroleum Products

5. **Advances in Gas Turbines and Free Piston Engines and their Effect on the Petroleum Industry.** The Texas Co.
USA. **Mon. PM.**

7. **Comparison of Performance and Octane Number Requirements of American and European Cars.** Mobil Oil Co., Ltd. Mobil Oil AG., Mobil Oil Italiana S. P. A. Mobil Oil Francaise.
Germany. **Tues. AM.**

10. **Antiknock Compounds—Research, Development, and Refinery Application.** Ethyl Corp.
USA. **Tues. PM.**

12. **Oxidation Inhibitors for Modern Fuels.** Shell Development Co.
USA. **Wed. AM.**

20. **Synthetic Additives for Lubricating Oils. Influence of Additive Structure on their Activity.** Prof. P. I. Sanin et al.
USSR. **Thurs. AM.**

30. **The Properties of Petroleums that Supply World Trade, Especially Venezuelan Petroleums.** Ministry of Mines and Hydrocarbons.
Venezuela. **Mon. AM.**

(Continued)

OIL CONGRESS TECHNICAL PAPERS

Paper No. • **Title**
Organization or author
Country • **Time given**

Engineering, Equipment and Materials

2. **Pollution Prevention Through Design and Operation.** General Petroleum Corp.
USA. **Mon. PM.**

3. **Decomposition of Naphthenic Acids by Micro-Organisms in a Refinery Effluent Disposal System.** Shell Refining & Marketing Co., Ltd.
Gt. Britain. **Mon. PM.**

4. **Erosion in Gas-Solid Systems.** Koninklijke/Shell Laboratorium; N. V. De Bataafsche Petroleum Maatschappij.
The Netherlands. **Tues. AM.**

5. **Dynamics and Control of Distillation Columns.** Koninklijke/Shell Laboratorium; N.V. De Bataafsche Petroleum Maatschappij.
The Netherlands. **Tues. AM.**

7. **Reconciliation of American and European Steel Specifications.** Esso Research & Engineering Co.
USA. **Tues. PM.**

8. **Some Aspects of Corrosion Prevention in a Refinery.** The British Petroleum Co., Ltd.
Gt. Britain. **Tues. PM.**

13. **Advances in Process Plant Engineering.** The M. W. Kellogg Co.
USA. **Wed. AM.**

14. **Use of a Large Computer in Making Economic Designs.** Esso Research & Engineering Co.
USA. **Wed. AM.**

16. **Principles of Improving Flow Reactor Efficiency in Petrochemical Processes.** Prof. A. N. Planovsky; Prof. D. I. Orochko.
USSR. **Wed. PM.**

OIL CONGRESS TECHNICAL PAPERS

Paper No. • Title
Organization or author
Country • Time given

19. **Causes and Prevention of Explosions in Petroleum Processes. Standard Oil Co. (Ind.).** USA. **Thurs. AM.**

22. **A Theory of Complex Recycle Processes for Petrochemical Synthesis.** Prof. M. F. Nagiev. USSR. **Fri. PM.**

Symposium on the Applications of Atomic Energy to the Petroleum Industry.

1. **Probable Impact of Atomic Energy on the World Petroleum Industry.** Dr. Robert E. Wilson. USA. **Mon. PM.**

3. **Technical and Economic Prospects of Atomic Energy in the Petroleum Industry.** Schlumberger Well Surveying Corp. USA. **Tues. AM.**

4. **A Novel Approach to Control of Separation Processes Using Radioisotopic Compounds.** California Research Corp. USA. **Tues. AM.**

6. **Radioisotopes in Fuel and Lubricant Research.** Esso Research & Engineering Co. USA. **Wed. AM.**

9. **Radiation Promoted Hydrocarbon Reactions.** Esso Research & Engineering Co. USA. **Wed. PM.**

10. **Radiation Chemistry of Light Hydrocarbons.** Humble Oil & Refining Co. USA. **Wed PM.**

11. **Studies in the Radiation Chemistry of Petroleum Hydrocarbons and the Applications of Nuclear Radiation to the Petroleum Industry and Petrochemical Synthesis.** Prof. A. V. Topchiev et al. USSR. **Wed. PM.**

TECHNICAL

Of Commendable Clarity

FLUID DYNAMICS AND HEAT TRANSFER. By James G. Knudsen and Donald L. Katz. McGraw-Hill Book Co., New York. 576 pages. $12.50.

Reviewed by Ralph P. Stein, Engineering Research Laboratories, Department of Chemical Engineering, Columbia University, New York.

In its present form, this book is ideally suited as a text. It's a revised and greatly enlarged version of a University of Michigan Engineering Research Bulletin published five years ago.

Now it's at a first year graduate level for courses in convection heat transfer when such topics as heat transfer to compressible fluids and boiling heat transfer are not to be included in the course.

It is my opinion that the authors were wise in deciding not to attempt to include these and other heat transfer topics in a single book of this type. These limitations have allowed them to present detailed derivations of fundamental equations and their applications with commendable clarity. In addition, they are able to assemble a large amount of material, both theoretical and practical, old and new, that so far as I can determine, has never been previously assembled under one cover.

It's somewhat disappointing, however, that some analytical solutions to natural convection problems were not included, especially since the necessary background material is more than adequately covered.

The book is divided into three parts with appendixes. The first part discusses the important physical properties of fluids, presents derivations of the general flow and energy equations, and then gives a brief account of nonviscous flow theory with applications. The vector calculus is not used, although occasionally

BOOKSHELF

J. B. BACON

alternate forms of equations are given in vector notation.

The second part of the book concerns itself with viscous flows. Incompressible laminar and turbulent flows, both inside ducts of many shapes and past immersed bodies, are covered. Adequate treatments of the Reynolds stresses, universal velocity profiles, dimensional analyses and boundary layers are included. Also included are brief but useful discussions of the use of pitot tube and hot-wire anemometers for measuring velocity distributions and turbulent fluctuations. A good balance between analytical and experimental results is achieved. The second part of the book ends with an interesting discussion and presentation of data for flow through the shell side of commercial heat exchangers.

The third part covers convection heat transfer to incompressible fluids in both laminar and turbulent flows. Included are various forms of the Graetz problem, the Reynolds analogy and its extensions by others, a chapter devoted to heat transfer to liquid metals, and a final chapter on convection to fluids flowing past immersed bodies. The last chapter ends with a section on heat transfer from the shell side of commercial heat exchangers, which is perhaps somewhat sketchy compared to the earlier treatment on flow through such equipment.

The appendixes include outlines of vector notation and the use of conformal mapping for nonviscous fluid flow problems. A good collection of problems for each chapter is also included.

Your reviewer recommends this book not only for the graduate student, but also as a source of material for the analytical engineer working with convection heat transfer problems. The good balance between analytical and experimental results throughout the book makes it particularly suitable for this purpose.

LETTERS:

Large Plastic Fittings

Sir:

Congratulations on your very thorough treatment of the subject of plastic pipe (Mar. 23, 1959, pp. 149-170). As Mr. Sorell noted, the growing use of plastic pipe can certainly be described as "explosive."

In this connection, I'd like to call attention to one of the more recent production advances—increasing the available size range of injection-molded UPVC (unplasticized polyvinyl chloride) fittings. The article states (p. 159):

"The high cost of (injection molding) practically restricts sizes of (thermoplastic) fittings produced and stocked to the common pipe sizes, that is, ½ through 4 in. Fittings for larger-diameter pipe are custom-fabricated by a combination of machining and welding operations."

Actually, we have been producing and stocking 6-in. (and in some cases 8-in.) elbows, tees, bushings, flanges, etc., of injection-molded UPVC for several months. They can safely withstand as much as 12 times higher pressure (to 600 psi.) than the custom-fabricated fittings.

We have also announced recently the installation of a 1,500-ton injection molding press of

PRO & CON

C. H. CHILTON

our own design that produces the fittings for the large sizes of UPVC pipe. To the best of our knowledge it is the largest press of its kind ever designed.

The 6-in. stock fittings make it possible for engineers to utilize the full strength of UPVC pipe in the large sizes. These fittings have already been used in numerous process piping installations. Six-in. UPVC pipe and injection-molded fittings form the main risers of a system now under construction that is believed to be the largest UPVC corrosive-waste drainage system ever installed in this country.

CARL B. MCLAUGHLIN
Tube Turns Plastics, Inc.
Louisville, Ky.

Sir:

I have discovered two errors in my article on plastic pipe:

In Table VI, page 163, short-time tensile strength of laminated epoxy-glass should be 40,000; 80,000 (not 40,000; 8,000). On page 170, the Commodity Standards Div. is part of the Dept. of Commerce, not Agriculture.

G. SORELL
M. W. Kellogg Co.
New York, N. Y.

Don't Worry About Ph.D.'s

Sir:

In his interesting letter to you published March 9 (p. 203), Mr. Ullmann states that British M.S. and Ph.D.'s are pure research degrees. This is not strictly true. In a number of British universities the M.S. degree can be obtained either by research or by a prescribed course of study. Mr. Ullmann is quite correct, however, as to the British Ph.D.

Your otherwise excellent article on an alternative route to the Ph.D. degree (Jan. 12, 1959, pp. 142-146) is misleading in one respect: The new British technological qualification is not a Ph.D. but merely its approximate

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equivalent. The holders of the new British qualification will not in fact be privileged to use the title "doctor."

This should not, in any case, unduly perturb the British. Most of them take the attitude that the people who worry about Ph.D.'s don't matter, and the people who matter don't worry about Ph.D.'s.

F. A. HOLLAND
Lever Brothers Co.
Palisades Park, N. J.

Suspect Is Convicted

Sir:

Congratulations on the excellent article by E. D. Ermenc, "Design Data for Oxides of Nitrogen," which appeared in your February 23 issue (pp. 139-142).

My only disagreement is with the statement in the second paragraph that nitrogen oxides "are suspected" of contributing to the smog problem.

This is not a matter of suspicion. Oxides of nitrogen are definitely known to be a most important factor in the formation of photochemical smog.

W. L. FAITH
Air Pollution Foundation
San Marino, Calif.

Con: Wasted Tank Volume

Sir:

The method for interface control appearing in your January 26 Plant Notebook (p. 124) has, I believe, been published in only slightly modified form several times before in *Chemical Engineering*.

The uniqueness of this most recent solution, however, is the inefficient use of the available tank volume. By eliminating the internal weir and using the entire tank volume for liquid, settling time will be increased by a factor of four if the sketch in the article is to scale. Suitable overflow can be installed near the top of the tank to maintain a constant level in the vessel.

R. E. LISCHER
Monsanto Chemical Co.
St. Louis, Mo.

▶ *Mr. Lischer is right; general principles of this method of interface control have been published*

before. However, novel feature in this case is the adjustment of interface level by rotating an elbow carrying the discharge leg.—ED.

JUST BETWEEN US...

Dear Readers:

Many of you follow the Chemical Consumption Index we run regularly in our Chemical Economics pages. And I have evidence—letters, phone calls, face-to-face inquiries—that some of you follow it with intense interest.

You have asked me how it all got started, what makes it tick, how good it is and where you can find all the monthly data in one place instead of having to go through 'leventy-six back issues of *CE*.

One reader wanted a compilation so badly he came into our office, grabbed our bound volumes and ran through about three-years' worth of Indexes himself.

Encouraged — or, perhaps, shamed—by such industry, we decided to pull all the Indexes we had published in the last ten years together in two packages—one this issue, p. 60, another soon.

(You'll find an Index roundup for 1939-48 on p. 100 of *CE* for February 1949.)

Our editors first put the Chemical Consumption Index together way back in 1938. Today it still has no published counterpart. There are production indexes, to be sure, but no profile of the ebb and flow of chemical consumption.

CE's Index is ultimately based on production data, too. But these data represent production in the industries which consume the biggest volumes of chemicals. In 1938 we analyzed the volumes of chemicals which went into various basic industries, decided on the 13 industries which still today make up the composite index, and weighted each in proportion to the tonnage of chemicals used. These weighted values have been recalculated each month ever since according to the

PRO & CON . . .

productive activities of each chemical-consuming industry.

In 1949 we reviewed the Index and found that the original industries selected, and their relative importance, were still valid.

We've had a couple of related surveys since then which indicate the Index is still pretty much on the beam. In May 1951 (p. 313) we compared the ten biggest chemical-consuming industries, and their relative ranking, according to government statistics, with comparable figures for 1946. There was virtually no change—and the ranking was just about what our weighted averages indicated at that time.

We did this again in July 1953 (p. 326). The same ten industries were still the biggest chemical consumers (fertilizers, pulp and paper, rayon, paints and varnishes, petroleum, glass, plastics, iron and steel, textiles, and coal products, in that order).

And the rankings were again quite similar, although glass had slipped a bit, and plastics, rayon, and paints and varnishes had gained a couple of notches.

In 1953 these ten industries accounted for 90% of all chemicals consumed by volume. So by adding in the three other industries —explosives, rubber and leather —that go to make up our monthly Index, we could account for nearly all chemicals used.

There may be weak spots today in the *CE* Index makeup. For example, there are good arguments for bringing soaps and detergents into the picture.

Were we to change the basis of the Index from physical volume to dollar volume, the whole list would need a working over. Pharmaceuticals would unquestionably belong, as would food and detergents. Presently low-weighted industries like textiles and rubber would rank among the richest markets for chemicals. Fertilizers and pesticides together would not rate the top spot held by fertilizers alone throughout the life of the present Index.

What do you think? We'd like your ideas on how *CE*'s Chemical Consumption Index may be made even more meaningful.

D. R. CANNON
Associate Editor
Chemical Engineering

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Chemical Engineering

Reader Service

STARTS ON PAGE 204

READER SERVICE . . .

TECHNICAL LITERATURE

E. M. FLYNN

Contents of This Issue

Chemicals

Aluminum Silicate Pigments.....Basic properties of full line of standard-grade pigments are described in 4 p. bulletin, Technical Information No. 1001. Data in tabular form.
204A Minerals & Chemicals Corp.

Butadiene.....styrene copolymer is used as the base for water emulsion paints & synthetic rubber. Technical assistance on the application of butadiene.
75 *Enjay Company, Inc.

Cacodylic Acid.....14 p. bulletin describes now use as a herbicide to renovate pasture and sod. Trademarked Arsan, it is known chemically as dimethylarsinic acid.
204B Ansul Chemical Co.

Carbon Dioxide.....CO_2 has a high vapor pressure at all times. It does not require metering of fuel and is uniformly pure at all times. Full details on this inert gas.
174 *Olin Mathieson Corp.

Cement.....A type of oxychloride cement floor called Sylox is discussed in 2 p. report 245. Photographs show locations where it is especially useful.
204C United Laboratories, Inc.

Chemicals.....Complete descriptive data & specifications, plus a sample of Powdered MgO, Granular MgO and Pelletized MgO is available.
115a International Minerals & Chem. Corp.

Chemicals.....New booklet "Chemicals for Resin Emulsions" contains information on thickeners, plasticizers, dispersants, stabilizers & other additives.
87a *Union Carbide Chemicals Co.

Coal Chemicals.....28 p. booklet, "The Age of Coal Chemicals," describes the development of the industry and part company has played therein.
204D United States Steel

*From advertisement, this issue

Coating, Silicone.....Efficiency of grinding wheels when made with company's A-1100 Silane coating for abrasive grains is discussed in data sheet SF-1159.
204E Silicones Div., Union Carbide

Epoxy Cement.....How to use Metalset A-4 epoxy resin aluminum cement, illustrated examples of typical uses, data on the compound are provided in a 4 p. bulletin.
204F Smooth-On Mfg. Co.

Essential Oils.....4 p. brochure, "An Important New Advance in Essential Oil Research," covers reconstituted oil Bergamot, first oil entirely made by chemical synthesis.
204G Fritzsche Bros.

Ethers & Oxides.....A 64-pg. booklet is available. Applications for detergents produced from ethylene oxide are found in domestic washing machines, utensil cleansers, etc.
87d *Union Carbide Chemicals Co.

Ethylene Oxide.....Complete information on handling & operating methods when using ethylene oxide is now available on your request.
87b *Union Carbide Chemicals Co.

Filter Aid.....Solka-Floc is highly purified, finely divided cellulose. Adsorbs many metals such as iron, copper, other impurities. It makes a stable pre-coat.
198 *Brown Company

Filter Fabricators.....8 p. bulletin describes products, facilities and services of firm offering complete line of filter cloth, filter specialty items, counseling, tests.
204H Technical Fabricators, Inc.

Hydrochloric Acid.....44p. manual, "Dow Muriatic Acid," covers properties of muriatic acid solutions, principal reactions and uses. Includes drawings, tables, graphs.
204I Dow Chemical Co.

Methylene Chloride.....A test sample & literature on methylene chloride is available. Also literature on other chloromethanes can be furnished at your request.
67 *Allied Chem., Solvay Process Div.

Want to build up your files and keep them up-to-date? You can get any publication in this comprehensive guide — free — just for the asking.

It's easy — simply circle item's number on the Reader Service Postcard and mail. Replies will come directly from companies offering the literature.

Nonionic Surfactants.....Ethylene oxide is an economical base for nonionic surfactants. Data on Tergitol nonionic surfactants for detergents is offered.
87c *Union Carbide Chemicals Co.

Paraformaldehyde.....in present equipment produces larger batches & shorter cycles. In new installation it eliminates heated storage tanks & reduces steam, electricity.
61 *Celanese Corp. of America

Phenol.....Freezing point a minimum 40.6C, its distillation range is only 2 degrees from first point (180C) to dryness. Information on handling phenol in Bul. 166.
103a *Hooker Chemical Corp.

Pelletized Borohydrides.....resist crushing or dusting. They are 10/32" & 24/32" in diameter. Bulk density averages five lbs. to the gallon. Complete details.
69 *Metal Hydrides Inc.

Rubber.....24 p. "Rubber Fact Book" give size numbers and dimensions of all common industrial O-rings. Sizes are cross indexed for comparison with other dimensional specs.
205A Minnesota Rubber Co.

Sodium Borohydride.....Tech. bul. No. 550 covers the availability, the properties & the storage & handling. Also includes analysis & uses of sodium borohydride-SWS
205B Metal Hydrides Inc.

Sodium & Potassium Borohydride..... A manual of techniques covering properties, reactions & handling & safety of sodium & potassium borohydride is now available.
205C Metal Hydrides Incorporated.

Textiles.....1959 Fiber Facts, pocket size booklet contains latest fiber data and textile information. Fiber properties are tabulated for easy comparison.
205D American Viscose Corp.

Urethanes.....4 p. bulletin gives complete specifications of ten machines for metering and mixing urethane prepolymers for foaming in place.
205E Dayton Rubber Co.

Construction Materials

Alloy.....“Hom” is a special high nickel alloy developed to produce castings that meet high temp. requirements when castings are subject to oxidizing atmospheres.
188 *The Duraloy Co.

Alloys.....for problems from high temp. oxidation, carburization or from corrosion due to nitriding gases or chemicals in flue gases. “Hastelloy Alloy X” booklet.
163 *Haynes Stellite Co.

Aluminum.....New brochure gives complete specifications for the hundreds of alloys and forms of aluminum available from the manufacturer. Bibliography.
205F Reynolds Metals Co.

Aluminum.....Non-rusting, corrosion-resisting aluminum offers light weight (⅓ the weight of steel). Many applications in chemical and petroleum processing. Details.
24-25 Reynolds Metals Company

*From advertisement, this issue

LITERATURE . . .

Ceramic Compositions.....available in granular & in fabricated form to meet your requirements. Complete details in booklet, "Norton Refractory Grain."
27 Norton Co., Refractories Div.

Coatings.....A pioneer in the manufacture & application of internal & external protective coatings for equipment of all kinds. Catalog is offered.
200 *Lithcote Corporation

Coatings Protective.....Bulletin 259 charts protective coatings for steel, concrete and wood where corrosive spillage, and fumes are involved.
206A Wisconsin Protective Coating Corp.

Coatings, Silicone.....4 p. brochure tabulates properties and application data on a high heat resistant silicone-base finish. Uses include missiles and aircraft.
206B Midland Industrial Finishes Co.

Coatings, Urethane.....4 p. leaflet, "Urethane Coatings, A New Approach to the Old Problem of Preventive Maintenance," covers aircraft, industry, transportation use.
206C Poly Form Mfg. Co.

Linings.....Cementable Teflon is available in continuous tapes .005″ through .096″, through 24″ wide; & in sheet through 48″ x 48″. Catalog AD-158.
175 *The Garlock Packing Co.

Metals.....Illustrated catalog gives complete information on clad metals, thermostat metals, solid & clad precious metals & industrial metals. Also electrical contacts.
206D Metals & Controls Corp.

Metal Gaskets.....New bulletin describes the design, construction and utility of Guardian spiral-wound metal gaskets. For gases and liquids in high pressures, temperatures.
206E Garlock Packing Co.

Packings, Tower.....Resists high temperatures, fumes, vapors, corrosion, liquids, alkalies & acids. Complete information, prices & samples available on request.
T210 *Knox Porcelain Corp.

Phosnic Bronze.....Phosnic bronze is a high-copper alloy that combines high strength, electrical and thermal conductivity. Completely discussed in new booklet.
206F Chase Brass & Copper

Rubber & Plastics.....Chemical resistant equipment such as plastic pipe, pachydermous pail, linings, fittings, valves, etc. Bulletins 80A & CE-53 give details.
170 *American Hard Rubber Co.

Stainless Steel.....Data on 17-4 PH Stainless Steel & a copy of booklet, "How Stainless Steels Serve the Petrochemical Industry," can be obtained on request.
99 *Armco Steel Corp.

Electrical & Mechanical

Casters & Wheels.....Feature rubber treads, rust-proofed, string guards, and lubrication. A manual outlining all features in detail is now available.
L215 *Darnell Corp. Ltd.

*From advertisement, this issue

Couplings, Reducing.....now available for the use with basic-check units. Supplied in line sizes from ⅜" to 2". Full story contained in a new 8-page bulletin. CE-59.
202 *Durable Mfg. Co.

Drive.....Variable speed drive with finger-tip control gives you instantaneous speed changes even under load, without belts, pulleys, or gears. Bul. D-2505.
233 *Reliance Electric & Engr. Co.

Drive Adjustable-Speed.....Bulletin 2750 presents information on the redesigned Adjusto-Spede drive in ratings of ¾ to 7½ hp. Dimensions, cutaway views.
207A Louis Allis Co.

Drives & Couplings.....Bulletin on Dyna-V drives selection data, Paraflex couplings data & Flexidyne drives & couplings are available on request.
169 *Dodge Mfg. Corp.

Gearmotors.....offer a wide variety of sizes in single, double, triple or quadruple reductions . . . horizontal or vertical foot or flange mountings. Bul. MU-227.
95-96a *Wagner Electric Corp.

Hydraulic Components.....Hydraulic, pneumatic and vacuum catalog contains flow charts, JIC piping, and other helpful information. Data on tube and pipe fittings.
207B Lenz Co.

Mechanical Seal.....Mechanical seal for pumps handling water or light hydrocarbons in the higher-temperature range is described in new bulletin. Called the Dura Seal.
207C Durametallic Corp.

Motor Control.....A complete line of low voltage control (size O through 8) & high voltage control in all NEMA enclosures, plus engineered control systems. Details.
101 *Allis-Chalmers, Gen Prod. Div.

Motor Drive.....Illustrated publication No. 243 tells how Ampli-Speed works and how to select right model from easy-to-use charts. Input speeds can be 860 thru 1750 rpm.
180 *Electric Machinery Mfg. Co.

Motors.....C-W Sealedpower motors now available up to 300 hp in totally-enclosed, fan-cooled & explosion-proof designs. All the facts in new bulletin PB 6000-2.
179 *Elliott Co.

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95-96c *Wagner Electric Corp.

Motors.....Type DP is available with ball bearings or with high load carrying capacity sleeve bearings for extra quiet operation. Bulletin Mu-223.
95-96b *Wagner Electric Corp.

Motors Helical Gear.....New bulletin describes in text and pictures the construction features and applications of helical gear-motors and speed reducer line.
207D General Electric Co.

Motors, Open.....Super-Seal is completely unaffected by moisture, dust, dirt, oil, acids & alkalis. Information available on this & the Silco-Flex.
189 *Allis-Chalmers

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LITERATURE . . .

Pillow Blocks.....Ball bearing pillow blocks with normal duty shaft sizes ½" to 2 7/16" and medium duty shaft sizes 1 7/16" to 3½". Fully self-aligning. Tech. Bul.
168 *Dodge Mfg. Corp.

Speed Reducers.....incorporate case-hardened worms & nickel-bronze gears. Facts on how right-angle speed reducer can benefit your operation or process, Bul. 145.
59 *Cleveland Worm & Gear Co.

Torque Wrench.....A new manual outlining torque principles is offered. Included are drawings, price list & the torque specification chart.
208A P. A. Sturtevant Company

Turbines.....Sizes from 1 HP to 250 HP. Feature a totally enclosed governor . . . totally enclosed, independently operated safety trip . . . brake rim for added safety.
83 *Coppus Engineering Corp.

Unilets.....You can get practically anything needed for wiring or lighting in hazardous or non-hazardous areas. Full information on request.
38 *Appleton Electric Co.

Handling & Packaging

Bucket Elevator.....A complete line makes it easy to select the proper type bucket elevator & components best suited to your material & capacity requirement. Details.
6 *Link-Belt Co.

Cans.....“F” style cans have a recessed bottom that fits securely on top of can below. Available in 5 convenient sizes ranging from 8 oz. to 1 gallon size.
53 *Continental Can Co.

Chlorinator.....A booklet “The V-notch Story” will tell you about all the V-notch chlorinator features. Also information on both gravimetric & volumetric feeders.
199 *Wallace & Tiernan Inc.

Conveying Guide.....A 12-page conveying guide discusses types of systems, illustrates & diagrams high & low density arrangements & shows equipment. Bul. M-588.
196a *The Day Company

Conveyor, Air Gravity.....Air-Float for moving dry, pulverulent materials horizontally. Literature describing this & the complete pneumatic conveying systems offered.
R216 *Kennedy Van Saun

Floating Transportation.....New brochure includes sections on towboats, barges and specialized equipment, and operations and facilities of the company.
208B St. Louis Shipbuilding

Magnetic Drums.....for automatic continuous removal of medium fine iron & tramp iron from foods, grains, plastics, etc. Literature includes installation & application.
208C *Eriez Mfg. Co.

Payloader.....The Model H-25 has extraordinary protection against dust & dirt damage. Special oil & grease seals on all vital points. Data available.
29a *The Frank G. Hough Co.

*From advertisement, this issue

LITERATURE . . .

Storage Tanks.....Bulletin 574 describes horizontal & vertical storage tanks. Filled with photos of various installations plus description of auxiliary equipment.
196b *The Day Company

Heating & Cooling

Equipment.....Bul. E-1 shows designs in heat exchanger, oil chillers, crystallizers, steam generators, & ice making & refrigerating machinery for application in industry.
147 *Henry Vogt Machine Co.

Heat Exchanger, Plate.....All heat transfer surfaces are exposed for manual cleaning with a minimum of trouble. Get complete information on this process equipment.
14-15c *The De Laval Separator Co.

Heat Exchangers.....constructed so that all surfaces in contact with corrosive fluids are of "Karbate" impervious graphite. Catalog Section S-6800 is offered.
91 *Nat'l Carbon Co.

Heat Transfer.....New Multi-Zone Plate-coil provides a reserve of heating & cooling capacity for faster heat transfer. Bul. P61 gives complete specifications.
232 *Tranter Mfg. Inc., Platecoil Div.

Heaters, Bayonet.....Tantalum envelope over inner distributor tube of carbon steel which serves as steam ejector. Other units in tantalum. New tantalum bulletin offered.
234b *Pfaudler Permutit Inc.

Kilns, Rotary.....Bulletin No. 1115 gives complete information on these kilns as well as details of the precision built & rugged machinery for the chemical industry.
21 *Taylor Engineering & Mfg. Co.

Steam Traps.....The 44-page book gives specific data on the selection & sizing of traps. Also information on design & construction of Inverted Bucket Steam Traps.
80 *Armstrong Machine Works

Vaporizers.....All units, vertical or horizontal, are compact, self-contained, automatic heating plants. Catalog A-100 covers both vertical & horizontal types.
104 *Eclipse Fuel Engineering Co.

Instruments & Controls

Analyzer, Heat Prover.....Two meters on the analyzer show per cent by volume of oxygen & combustibles an either a 20% range span or a more sensitive 4% range. Facts.
98 *Bailey Meter Co.

Analyzer Infrared.....4 p. Bulletin 700 has been revised to reflect improvements made in Series 700 Infrared Analyzer. Describes operation in detail.
209A Analytic Systems Co.

Computer.....Bulletin describes many ways in which G-15 general-purpose computers are being used in the petroleum industry. Copies available on request.
209B Bendix Computer Div.

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T218 *Magnetrol, Inc.

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210A Protection Controls, Inc.

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33 *Fisher Governor Co.

Controls.....Self-powered automatic temp. regulators do not require compressed air or electrical wiring. No specialized maintenance required. Bulletin #620.
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210B Brooks Rotameter Co.

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T231 *The Liquidometer Corp.

Gauges.....Duragauges are available in pressure ranges from 15 psi (or vacuum) minimus to 100,000 psi. Three case materials. Catalog #1278 & complete facts offered.
28 *Manning, Maxwell & Moore Inc.

Gauges.....Catalog gives complete data on high pressure gauges, gauge cocks, large chamber reflex gauges & heated or cooled gauges.
L176 *Strahman Valves, Inc.

Instrumentation.....Illustrated data covers the manufacturer's newest equipment. Front cover carries design tables useful to engineers. Automation-instrumentation issued.
210C U.S. Controls Inc.

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194 *Neptube Meter Co.

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210D Sharples Corp. Research Labs

Millivoltmeters . . . . . New 28-page catalog describes operating principles, specifications, features and ordering information on noncontrol and control millivoltmeters.
210E Minneapolis-Honeywell

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210E Beckman/Scientific Instruments

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Temperature Controls.....New booklet gives a description of how Thermoswitch units operate on the differential expansion of metals. Specifications and features.
214A Fenwal Inc.

Transmitter.....The 13AA Absolute Pressure Transmitter is ideal for use with low pressure fractionating columns, evaporators, & vacuum crystallizers. Bul. 458-22A.
65 *The Foxboro Company

Viscometers.....Synchro-Letric Viscometrans provide accurate measurement, evaluation & control of viscosity in fluid. Information.
L 217 *Brookfield Engineering Lab.

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214B Garlock Packing Co.

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161 *Resistoflex Corporation

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183 *Camco Fittings, Inc.

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49 *Goodyear, Industrial Prod. Div.

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1 *B. F. Goodrich Ind. Prod. Co.

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190 *Mueller Brass Co.

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171c *American Hard Rubber Co.

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R209 *Alloy Steel Products Co.

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Process Equipment

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R208 *Sturtevant Mill Co.

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16 *Commercial Filters Corp.

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216A Komline-Sanderson Eng. Corp.

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26 *Buffalo Forge Company

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1—FLETCHER 30" stainless Centrifugal, Susp., perforated basket, vaportite.
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1—Allis-Chalmers 10' x 90' Rotary Kiln 9/16" shell. Complete
1—Shell & Tube S. S. Heat Exchanger, ¾ tubes, 640 sq ft area
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Percolator: Pfaudler 54 x 42" st. st. jack.
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1—AT&M 26" suspended Centrifuge, perforated basket, 316 S.S.
2—Oliver 8' x 8' Precoat rubber covered Rotary Vacuum Filters.
1—Oliver 3' x 4' lead Rotary Vacuum Filter
4—Sperry 36" rubber covered Plate & Frame Filters, 30 chambers.
2—Sperry 42" Aluminum Recessed Filters, 30 chambers.
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1—Mikro Pulverizer, 3TH, motor driven.
2—Abbe 5' x 16' brick lined Mills.
3—30" dia. Stainless Steel Micronizers complete with Hoppers, Conveyors, etc.

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1—Traylor 11' x 155' Rotary Kiln, ¼" shell welded, 2 tires.
1—Vulcan 8' x 125' Rotary Kiln, ¼" shell riveted, 2 tires.
1—Vulcan 8' x 50' Rotary Kiln, ¼" shell welded, 2 tires.
2—Rennenberg 6' x 60" Rotary Kilns, ¼" shell riveted.
1—Traylor 5' x 50' Rotary Dryer, 716" shell welded, 2 tires.
1—Proctor & Schwartz 8' wide x 60' long Conveyor Dryer, Stainless Steel Belt.

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4—3400 gal. 8' x 8' with Nettco Turbo Agitators, 15 HP motors.
1—4000 gal. 10' x 7'6" with Nettco Turbo Agitator, 10 HP motor.
1—4500 gal. 9' x 9' with Nettco Turbo Agitator, 3 HP motor.
1—5000 gal. 9' x 10' with Nettco Turbo Agitator, 15 HP motor.
5—8500 gal. Vertical Storage, 8'6" x 16' x 8' cone.
1—10,500 gal. Horizontal Storage, 10' x 18'.
1—13,000 gal. Horizontal Storage 8' x 35'.

STEEL TANKS

4—2000 gal. 7' x 7' with Nettco Turbo Agitators, 10 HP motors.
1—3000 gal. 8' x 8' with Patterson Turbo Agitator, 10 HP motor.
1—5200 gal. 10' x 9' with Patterson Turbo Agitator, 10 HP motor.
15—Storage Tanks: 3800; 6000; 9000; 10,000; 15,000; 47,000 gal.

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3—Worthington, I.R. Compressors; 1000, 500 & 365 cfm, 30 psi.
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11—Steel Buildings 20' to 80' trusses.
2—Shepard Niles 20 ton Overhead Cranes.
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FILTERS, ROT. VAC.

2—5'3" x 3' Oliver, T316 SS, ASME 25#, 60 sq. ft.
1—10' x 12' Eimco, rubber-covered.
2—9'6" x 15' Oliver, rubber-covered.
1—8' x 8' Oliver, precoat.
1—6'6" x 6 Feinc. steel...
1—5'3" x 8' Oliver, precoat, UNUSED.
1—5'3" x 3' Oliver, rubber-covered.

REACTORS — FERMENTERS — KETTLES

1—1400 gal., T316 SS, ASME 175#, 65# jkt., agit.
2—750 gal. Fermenters, SS ASME 30# int. 30# jkt., 10 HP XP agit.
6—465 gal. reactors, T304 ELC SS, 150# int. 160# jkt.
1—450 gal. reactor T347 SS, 15# jkt., agit.
2—125 gal., T304 SS fermenters, ASME.
1—100 gal. T304 SS reactor, ASME vac. int. 75# jkt. UNUSED.
1—1000 gal. Pfaudler G.L. reactor, ASME 75# jkt., 25# int.
3—750 gal. Pfaudler model "R", glass, jkt. & agit.
1—600 gal. G/L reactor, jkt.
5—500 gal. Pfaudler G/L reactors, 25# int., 75# jkt.
1—30 gal. Pfaudler G/L reactor, 25# int., 75# jkt. Agit.
5—1800 gal. Steel Kettles, 180# jkt., paddle agit.
1—1500 gal. Steel Reactor, ASME 600# int., 150# jkt.
1—1000 gal., Dopp kettle, C.I., 25 HP Agit., ASME jkt.

CENTRIFUGALS, BASKET

1—48" A.T.&M. susp., T304 SS perf.
1—40" Bird, susp., steel, imperf.
1—40" Fletcher, susp., steel imperf.
1—36" Tolhurst, bronze center-slung.
1—30" Fletcher, susp., T304 SS perf.
1—30" Fletcher, underdriven, T304 SS.
1—26" Fletcher, underdriven, T316 SS.
1—26" Tolhurst, susp., steel perf.
1—12" Fletcher, underdriven, T304 SS.

DOUBLE DRUM DRYERS

3—Buflovak 42" x 120" 125# drums
1—American 42" x 120", atm.
1—Buflovak 42" x 90", atm.
2—American 36" x 84", Vacuum.
1—Buflovak 32" x 72", atm.
1—Buflovak 32" x 52", atm.
1—Witteman 22" x 38", atm.

BALL & ROD MILLS

1—Marcy 7' x 15' rod, 300 HP
4—A-C 7' x 24' compeb, 450 HP
4—A-C 5' x 22' ball-tube, 150 HP
1—A-C 6' x 15' ball, 150 HP
1—A-C 6' x 16' ball, 30 HP
1—Kennedy 4' x 8' rod, epd., 50 HP
1—Denver 4' x 10' rod, 30 HP
1—Hardinge 4'6" x 16' conical, 25 HP
1—Hardinge 6' x 36" conical, 75 HP

120,000 Sq. Ft. of Equipment in Stock

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#12 Sweetland Filter, w/bronze monel leaves
#2 Sweetland Filter, 23 leaves, 1½" centers.
(8) Sperry 18" C.I. Filter Presses, Type 41.
Hersey Hot Air Dryer 5'x26'—4" lg. S.S. shell.
(6) 700 sq. ft. Condensers. Alum. brass tubes. Muntz metal tube sheets. Tube side 2-pass.
(5) S.S. Continuous Centrifuges, 7" Laboratory, 40", 30" and 21". Solid bowl and Screen type.
50-gallon Stainless Steel Reaction Kettle.
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Driven by 2—700 H.P. Synchronous Motors, complete with starters, almost new

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Excellent condition

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CHEMICAL PROCESSING EQUIPMENT

1—Stainless Alloy Tank Co. type 347 SS 200 gal. jacketed autoclave, 250# internal and jacket pressures.
1—Stainless Alloy Tank Co. 125 gal. type 347 SS jacketed autoclave, 250# internal and jacket pressures.
4—Stainless Alloy Tank Co. 100 gal. type 347 SS pressure tanks, 250# pressure.
1—Stainless Alloy Tank Co. 300 gal. type 347 SS pressure tank, 250# pressure.

AUTOCLAVES, KETTLES AND REACTORS

1—Blaw-Knox 400 gal. steel jacketed autoclave, 570# internal pressure, 85# jacket
1—Columbia Engineering high pressure storage tank, 2400 gal. 265# working pressure
1—Dover Tank Co. horizontal 4000 gal. nickel tank, 30 psi
2—Pfaudler type 316 SS 700 gal. jacketed kettles with condensers, columns and receivers

DRYERS

4—Link Belt steel roto louver dryers, Model 207-10, 310-16, 310-20, 604-20
1—Link Belt steel roto louver dryer, Model 1003-30, complete
1—Buflovak double drum dryer 42" x 120"
1—Stokes Model 59DS steel rotary vacuum dryer, 5' x 30'
1—Stokes double drum dryer, 5' x 12'
1—Louisville rotary steam tube dryer, 8' x 45'
1—Louisville SS rotary kiln, 30" x 28', complete
1—Stokes SS rotary vacuum dryer, 2' x 6'
6—Stokes steel jacketed rotary vacuum dryers, 3' x 15'
1—Louisville SS rotary dryer, 8' x 50'
1—Louisville rotary dryer, 38" x 40' Type L

FILTERS

1—Oliver horizontal filter, 6' 6"
1—Sweetland #3 SS filter
1—Niagara SS filter Model 510-28
1—Oliver Horizontal filter, 3'
1—Feinc SS rotary vacuum string filter, 3' x 3' (NEW)
10—Shriver plate and frame filter presses, 12" to 42"
12—Sweetland #12 filters with 72 SS leaves
1—Shriver rubber lined filter press, 36" x 36"
3—Dorco 6' x 2' rubber covered filters

MIXERS

1—Patterson jacketed vacuum SS kneader master mixer sigma blade, 300 gal. working capacity
3—Robinson type 316 SS sigma type jacketed heavy duty mixers, 300 gal. 60 HP.
5—Baker Perkins double arm sigma blade mixers, 100 gal.
1—Leader SS jacketed 51 cu. ft. ribbon blender
1—Patterson monel double cone blender, 4 cu. ft.
19—Robinson SS horizontal blenders, 255 cu. ft.

THE GELB GIRL—MAY 1959

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2—Heat Transfer Products steel bubble cap columns, 36" and 42" with 5 and 10 trays
1—Acme steel bubble cap column, 42" dia. with 10 trays
2—Patterson Kelley steel heat exchangers, 1000 sq. ft. each
6—Struthers Wells heat exchangers, 885 sq. ft.
1—Patterson Kelley steel heat exchanger, 427 sq. ft.
50—Steel heat exchangers from 15 sq. ft. to 400 sq. ft.
30—Struthers Wells SS heat exchangers, 650 sq. ft. each
1—Struthers Wells type 316 SS heat exchangers, 330 sq. ft.
10—Davis Engineering type 316 SS heat exchangers, 170 sq. ft. (NEW)
1—Badger type 316 SS bubble cap column, 42" dia. with 11 trays
1—Badger type 316 SS bubble cap column, 36" dia. with 8 trays
1—Vulcan SS bubble cap column 4' x 28 plates
1—Stokes Model DDS2 rotary tablet press
1—Struthers Wells SS calandria type evaporator, 365 sq. ft.
1—Swenson type 316 SS vacuum crystallizer, 3'6" x 12'
1—Swenson type 316 SS vacuum crystallizer, 2'6" x 12'
1—Swenson single effect evaporator SS, 320 sq. ft.
1—Blaw-Knox steel distillation column, 36" x 40' with 24 trays, complete (NEW)
3—Williams type 316 SS hammermills, Model AK
1—Mikro Model 4th pulverizer
1—Kent 3 roll high speed paint mill, 9" x 24" complete
1—Kent 20 gal. Super Pony mixer with 3 HP explosion proof motor.

1—Ames 300 HP steam generator, 150#
1—Cleaver-Brooks 500 HP package steam generator, 200#
10—Alco type 316 SS jacketed 3000 gal. reactors, complete with Turbine Agitators and drives, 50 psi.
2—Struthers Wells type 316 SS jacketed reactors, 3500 gal., complete with coils, agitators and drives.

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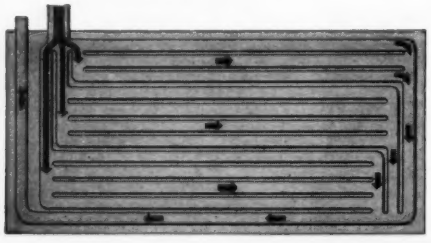

Operating pressures up to 250 psi

Higher pressure containment is achieved through the use of DURAWELD bonding of the plates and mill-controlled TRANSTEEL in standard MULTI-ZONE PLATECOIL units. This makes it possible to apply the time-proven advantages of PLATECOIL to many types of heating where 250 pound steam is required. Destruction tests have demonstrated a safety factor of more than 5 to 1.

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PLATECOIL costs are low compared to the cost of engineering, fabricating, installing and maintaining pipe coils. PLATECOIL units are lightweight for easy handling. They give more heat transfer per unit of surface. Compact PLATECOIL saves valuable tank space. Deposits do not build as readily on streamlined surfaces as they do on pipe coils. PLATECOIL is also relatively simple and economical to clean. With PLATECOIL, there need be no threaded joints below the liquid level to corrode or leak.

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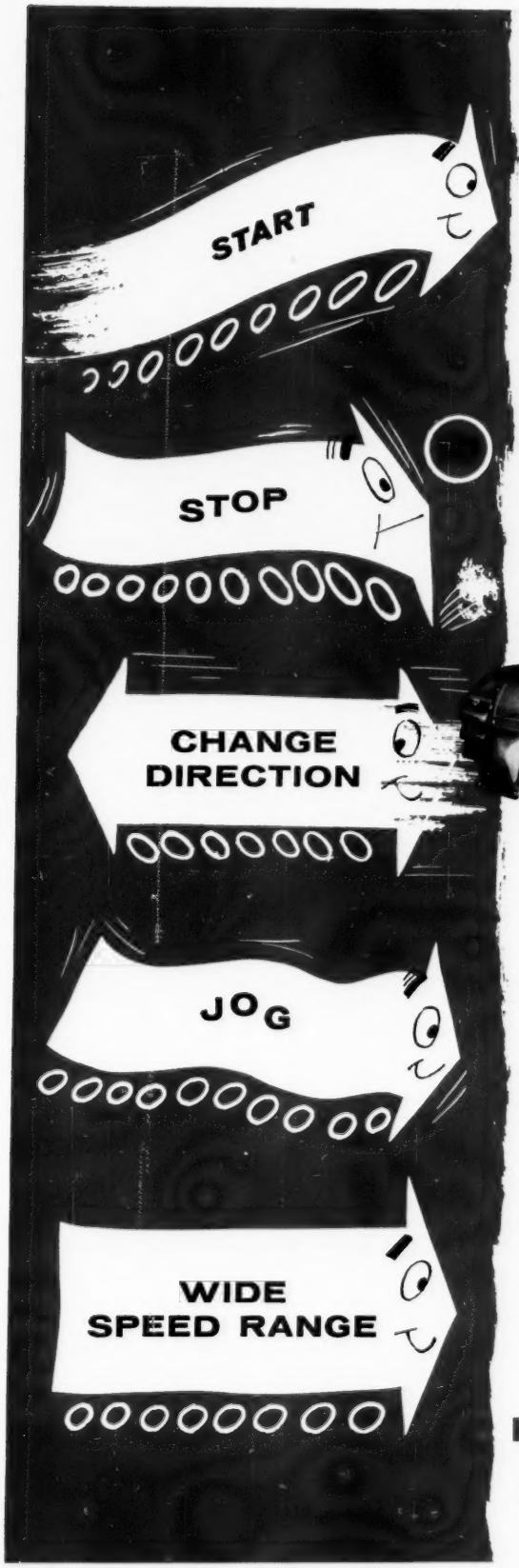

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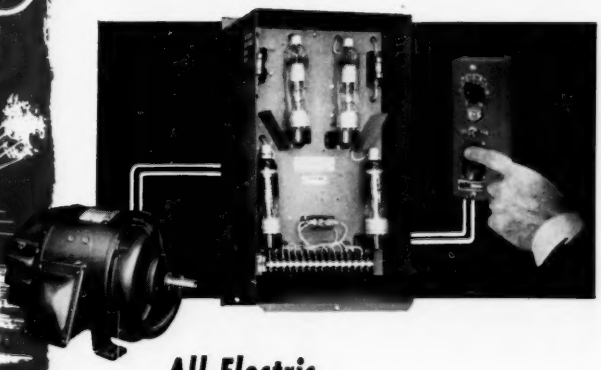

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Variable Speed Drive
with Finger-tip Control

The new V★S Jr. gives you instantaneous speed changes, even under load, without belts, pulleys, or gears. This Reliance Drive puts complete machine control at the operator's fingertips. All functions, jog, start, stop, reverse and speed changes are placed in a compact, remote control station.

The 8 to 1 motor speed ratio puts extra flexibility into your machinery. Speeds may be changed through this wide range as frequently as required. The motor will operate through a 100 to 1 speed range for jogging or light intermittent duty.

There's a big power cushion in the motor too . . . power for smooth speed pick up, even under heavy shock loads, and dynamic braking for fast controlled stops without shuddering or jerking.

The Reliance V★S Jr. is your answer to machinery drive problems in the ¾ to 4 horsepower range. Package construction makes installation easy; just plug it in to a single phase 220 or 440 volt a-c. line.

Write for Bulletin D-2505 for complete details. D-1554

RELIANCE ELECTRIC AND ENGINEERING CO.
DEPT. 135A, CLEVELAND 17, OHIO
CANADIAN DIVISION: TORONTO, ONTARIO
Sales Offices and Distributors in principal cities

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FLUIDICS

is a Pfaudler Permutit program providing
the know-how
the equipment
and the experience
for solving problems involving fluids

FLUIDICS covers such varied phases of fluid handling and control as:

corrosioneering
water treatment
waste treatment
reactions
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agitation
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distillation
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heat transfer

Whenever you have a fluid-handling problem, look to this Pfaudler Permutit program for the best solution.

NEW THROUGH FLUIDICS

Tantalum bayonet heaters with zero corrosion loss

Ten years of research and development work with tantalum at our Pfaudler Division continue to pay off with the first production of tantalum bayonet heaters.

Where recommended, tantalum has complete, 100% corrosion resistance. You can even eliminate corrosion loss factors from your design figuring.

Generally speaking, you can use these heaters with all acids except hydrofluoric and fuming sulfuric.

Since corrosive attack is non-existent, you have no fouling factor to consider. High wall conductance provides extremely high heat transfer coefficients.

Design: Tantalum envelope over inner distributor tube of carbon steel which serves as steam ejector. Tantalum sheet is extremely thin because of tantalum's high tensile strength.

Standard sizes: 1½" O.D. tubes in lengths to 72" in clusters up to 5 units, offering up to 12 sq. ft. of heat transfer area. Also 2" O.D. tubes in lengths to 84" in clusters up to 4 units with heat area up to 15 sq. ft.

Other developments in tantalum. 275-gallon tantalum lined reactor already being produced. Pfaudler is prepared to work in capacities of 1000 gallons and up. Also ready to make tantalum protected shell and tube heat exchangers in all practical sizes, having already made a 14 sq. ft. unit.

Write for the new tantalum bulletin to our Pfaudler Division, Dept. CEB-59, Rochester 3, New York.

Pfaudler Permutit is observing its 75th anniversary. The company has manufacturing plants in Germany (Pfaudler-Werke A.G.), Great Britain (Enamelled Metal Products Corp. Ltd.), Canada (Ideal Welding Co. Ltd.), Mexico (Arteacero-Pfaudler, S.A.), and Japan (Shinko-Pfaudler Co., Ltd.), and four plants in the U.S. Sales Offices and representatives in leading cities throughout the free world.

PFAUDLER PERMUTIT INC.

SPECIALISTS IN FLUIDICS ... THE SCIENCE OF FLUID PROCESSES